

## **EXHIBIT 65**

US006336311B1

(12) **United States Patent**  
**Bednar**

(10) **Patent No.:** **US 6,336,311 B1**  
(45) **Date of Patent:** **\*Jan. 8, 2002**

(54) **GANG-TYPE ROTARY LAWN MOWER WITH REAR ROLLER**

(75) **Inventor:** **Richard D. Bednar, Lake Mills, WI (US)**

(73) **Assignee:** **Ransomes America Corporation, Lincoln, NE (US)**

(\*) **Notice:** Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

This patent is subject to a terminal disclaimer.

(21) **Appl. No.:** **09/546,145**

(22) **Filed:** **Apr. 10, 2000**

#### Related U.S. Application Data

(63) Continuation of application No. 08/794,141, filed on Feb. 3, 1997, now Pat. No. 6,047,530.

(51) **Int. Cl.<sup>7</sup>** ..... **A01D 34/66**

(52) **U.S. Cl.** ..... **56/6; 56/13.6**

(58) **Field of Search** ..... **56/6, 7, 13.6, 13.7, 56/13.8, 255, 295, DIG. 3, DIG. 9-14**

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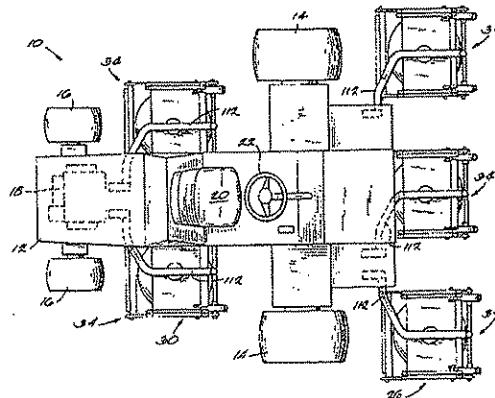
*Primary Examiner*—Robert E. Pezzuto

(74) *Attorney, Agent, or Firm*—Harness, Dickey & Pierce PLC

(57) **ABSTRACT**

A gang-type rotary lawn mower including a frame supported by wheels for movement over the ground, a power source which is mounted on the frame and which drives at least two of the wheels, an operator's seat mounted on the frame, a steering system enabling the operator to steer the lawn mower, at least two side-by-side front rotary cutting deck assemblies mounted on the frame, the front deck assemblies defining a gap between adjacent front deck assemblies, and at least one rear rotary cutting deck assembly mounted on the frame behind the front deck assemblies, each rear deck assembly being aligned with a respective gap between adjacent front deck assemblies, each of the front and rear deck assemblies including a single-spindle mulching deck defining a downwardly opening space, a single spindle mounted for rotation about a generally vertical axis within the space, and at least one cutting blade mounted on the spindle for rotation therewith.

12 Claims, 5 Drawing Sheets



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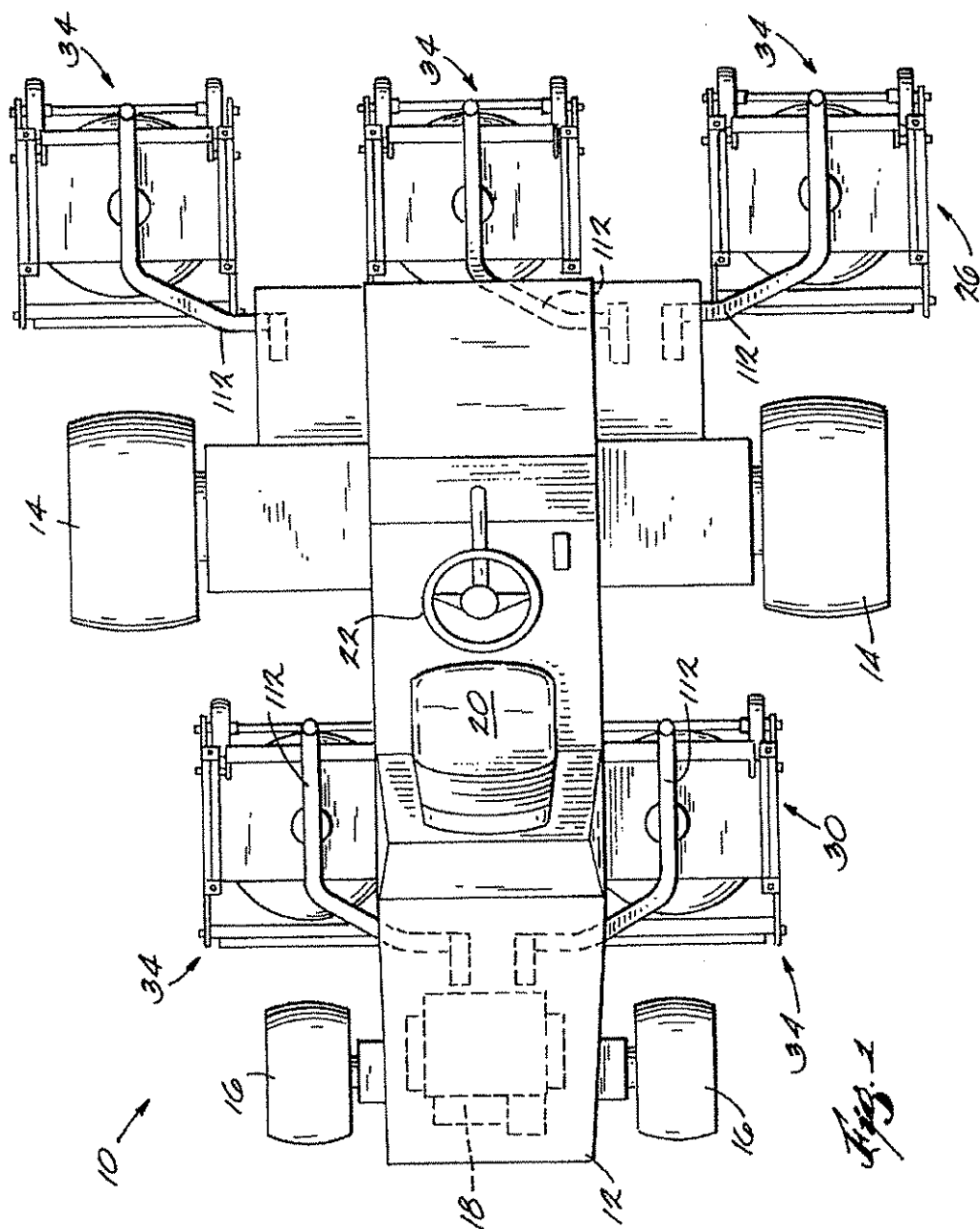
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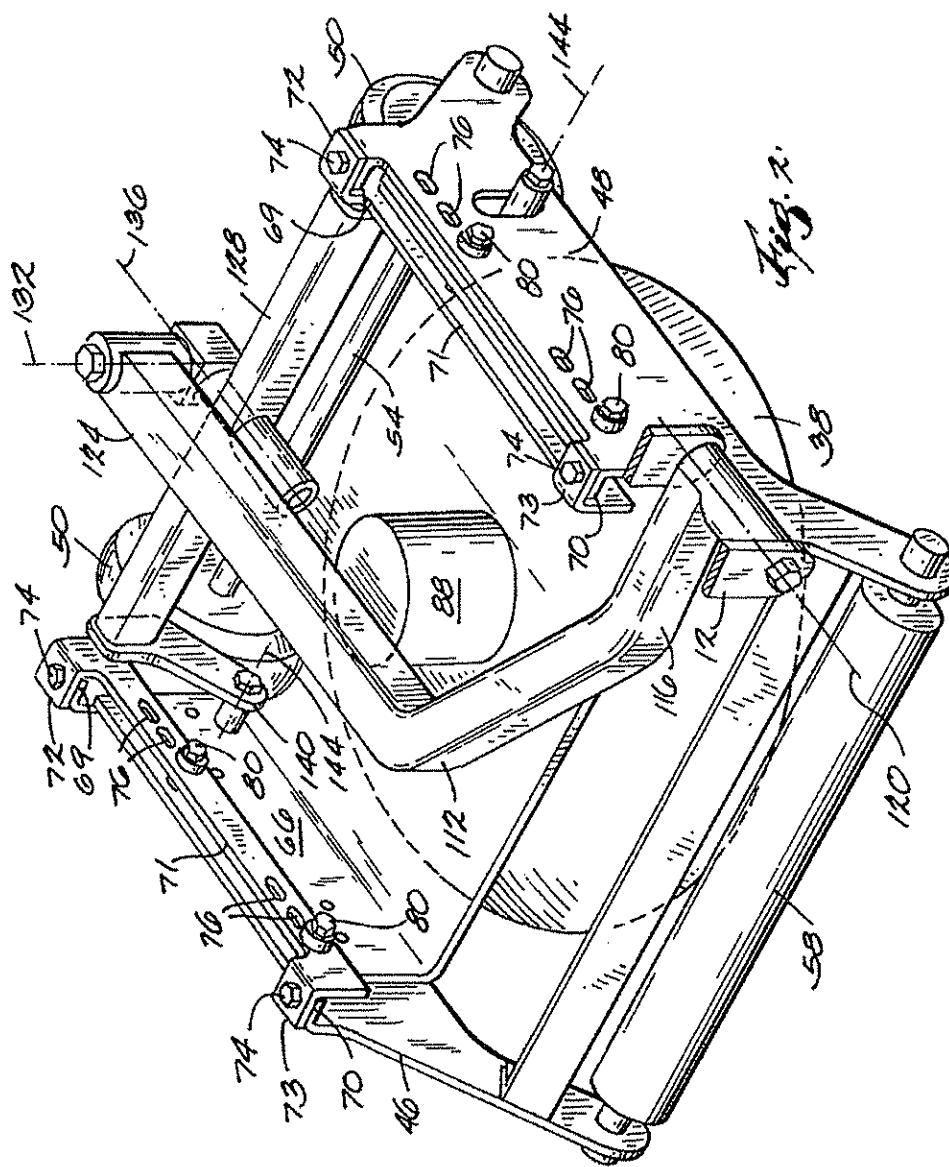


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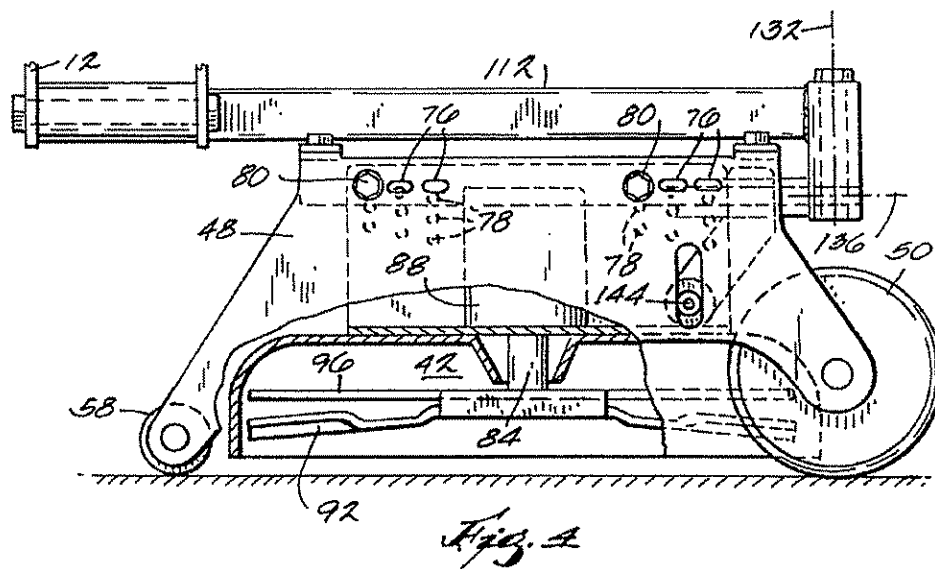
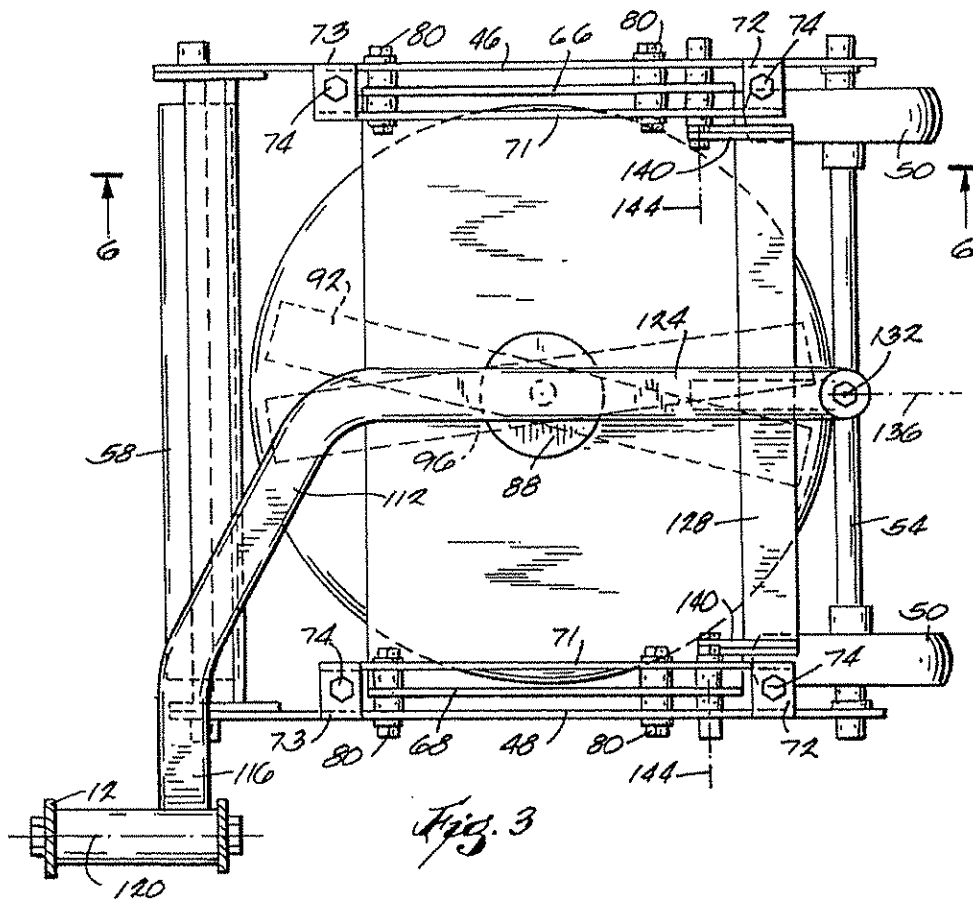


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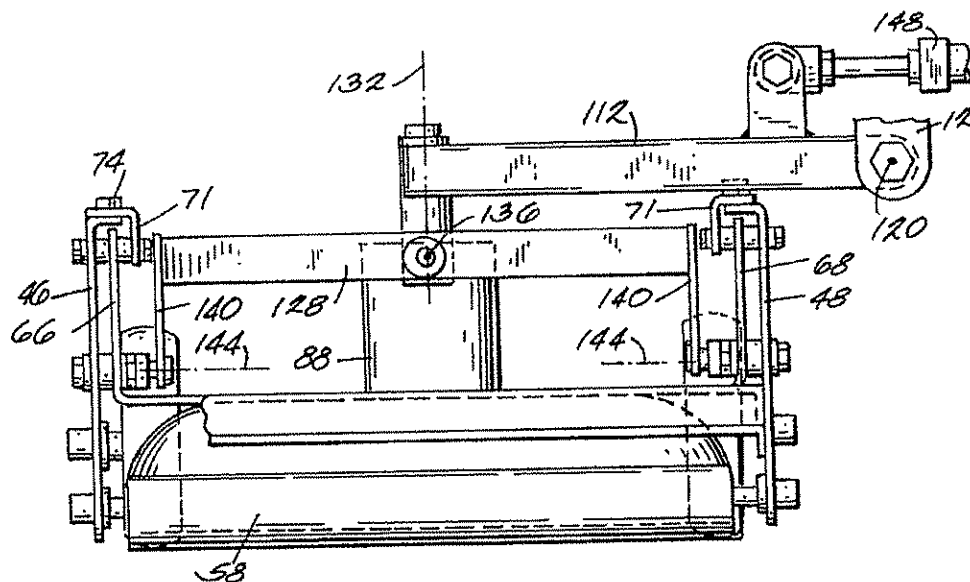


Fig. 5

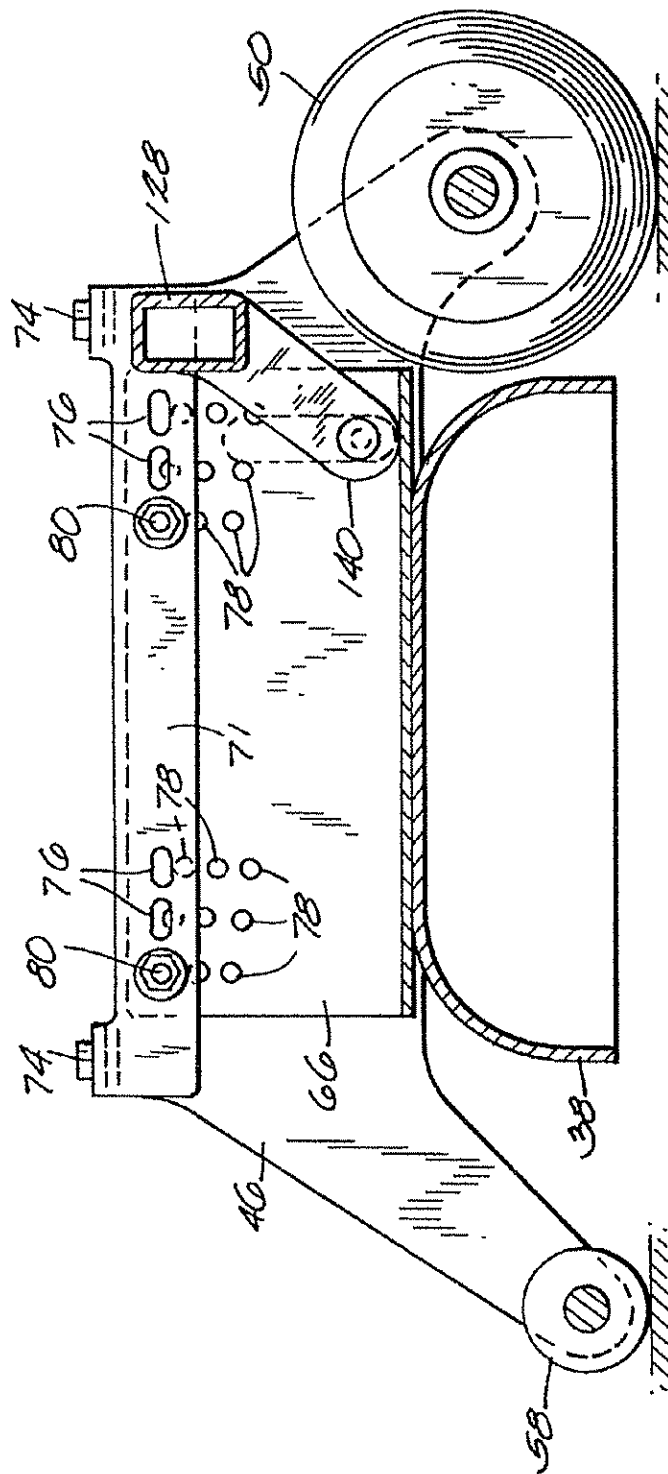
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*Fig. 6*





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**GANG-TYPE ROTARY LAWN MOWER  
WITH REAR ROLLER**

This is a continuation of U.S. patent application Ser. No. 08/794,141, filed Feb. 3, 1997, now U.S. Pat. No. 6,047,530.

**BACKGROUND OF THE INVENTION**

The invention relates to rotary lawn mowers and to gang-type lawn mowers.

Historically, reel mowers have been used to cut golf course roughs. It is generally recognized that rotary mowers are better suited for cutting tall grass, where scalping is not a problem, while reel mowers are better for shorter cutting. A gang of reels can be either attached directly to the frame on which the operator rides, or pulled behind a tractor. Pull-behind or tow-behind rotary gangs are also known. These can be driven either by a power takeoff or by a separate engine. Tow-behind gangs, whether reel or rotary, are generally undesirable for cutting a golf course rough because close trimming is difficult. Thus, rotary mowers have not been used to cut golf course roughs, which require close trimming and the ability to cut undulating terrain at a relatively short length.

**SUMMARY OF THE INVENTION**

The invention provides a gang-type rotary lawn mower suitable for cutting a golf course rough. This is a tremendous improvement over the known prior art, because a rotary mower typically requires substantially less maintenance than a reel mower. The lawn mower has single-spindle cutting decks attached directly to the frame on which the operator rides, with a front row of two or more cutting decks in front of the front wheels, and with a rear row of one or more cutting decks between the front and rear wheels. The invention also provides an improved arrangement for mounting a rotary cutting deck on a lawn mower frame. Each deck is mounted on its own lifting arm so that the deck can move vertically relative to the frame and can pivot relative to the frame about three mutually perpendicular axes.

More particularly, the invention provides a gang-type rotary lawn mower comprising a frame supported by front and rear wheels, an operator's seat mounted on the frame, at least two side-by-side front cutting deck assemblies mounted on the frame in front of the front wheels, and at least one rear cutting deck assembly mounted on the frame behind the front wheels and in front of the rear wheels. Each of the front and rear deck assemblies includes a pair of laterally-spaced, generally vertically-extending side plates, front wheels supporting the side plates for movement over the ground, and a rear roller extending between the side plates and supporting the side plates for movement over the ground. Each deck assembly also includes a single-spindle cutting deck located between the side plates and in front of the roller, the deck being mounted on the side plates such that the height of the deck relative to the ground is adjustable. The roller extends across substantially the entire width of the deck. The roller resists scalping and stripes the grass, both of which are aesthetically desirable.

Each deck assembly is connected to the frame by a generally L-shaped, horizontally-extending lifting arm operable to lift the deck assembly relative to the frame. Each deck assembly is connected to the frame by its own lifting arm. Each lifting arm has an inner end pivotally connected to the frame. A cross member is mounted on the outer end of the lifting arm for pivotal movement about a generally

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vertical axis and about a generally horizontal axis extending in the forward-rearward direction. One end of the cross member is connected to one of the deck assembly side plates for pivotal movement about a generally horizontal, laterally-extending axis adjacent the forward ends of the side plates, and the other end of the cross member is connected to the other side plate for pivotal movement about the same axis.

This construction enables the lawn mower to cut the undulating terrain of a golf course rough and to be controlled for close trimming. Also, as mentioned above, the lawn mower requires much less maintenance than the reel mowers historically used to cut a golf course rough.

Other features and advantages of the invention will become apparent to those skilled in the art upon review of the following detailed description, claims and drawings.

**DESCRIPTION OF THE DRAWINGS**

FIG. 1 is a top plan view of a lawn mower embodying the invention.

FIG. 2 is a perspective view of a cutting deck assembly.

FIG. 3 is a top plan view of the cutting deck assembly.

FIG. 4 is a side elevational view of the cutting deck assembly.

FIG. 5 is a rear elevational view of the cutting deck assembly.

FIG. 6 is a view taken along line 6—6 in FIG. 3.

Before one embodiment of the invention is explained in detail, it is to be understood that the invention is not limited in its application to the details of the construction and the arrangements of components set forth in the following description or illustrated in the drawings. The invention is capable of other embodiments and of being practiced or being carried out in various ways. Also, it is understood that the phraseology and terminology used herein is for the purpose of description and should not be regarded as limiting.

**DESCRIPTION OF THE PREFERRED  
EMBODIMENT**

A lawn mower 10 embodying the invention is illustrated in FIG. 1. Except as described below, the lawn mower 10 is identical to the lawn mower disclosed in U.S. patent application Ser. No. 08/787,389, filed Jan. 22, 1997, titled "PARALLEL-SERIES FOUR-WHEEL-DRIVE HYDRAULIC CIRCUIT FOR A RIDING LAWN MOWER" and assigned to the assignee hereof. The lawn mower 10 comprises a frame 12 (partially shown in FIGS. 2-5) supported by front wheels 14 and rear wheels 16 for movement over the ground. While the illustrated lawn mower 10 is rear-steering and has four-wheel drive, it should be understood that the invention is applicable to front-steering or two-wheel-drive lawn mowers.

The lawn mower 10 further comprises a power source 18 supported by the frame 12. The power source may be any type known in the art, such as a gasoline-powered, internal-combustion engine. The engine drives a hydraulic pump (not shown) that supplies hydraulic fluid to hydraulic motors (not shown) drivingly connected to the wheels 14 and 16. The lawn mower 10 further comprises an operator's seat 20, and a conventional steering system, including a steering wheel 22, enabling the operator to steer the lawn mower 10. In the illustrated construction, the steering system is hydraulic and is connected to the rear wheels 16 to steer the lawn mower 10.

The lawn mower 10 further comprises front and rear rows 26 and 30, respectively, of cutting deck assemblies 34. More

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particularly, in the illustrated construction, the lawn mower 10 has three side-by-side front cutting deck assemblies 34 in front of the front wheels 14, and two rear cutting deck assemblies 34 behind the front wheels 14 and in front of the rear wheels 16. As is known in the art, each rear deck assembly 34 is aligned with the gap between two adjacent front deck assemblies 34.

Each of the cutting deck assemblies 34 includes (see FIGS. 2-5) a single-spindle mulching deck 38 defining a downwardly opening space 42 (FIG. 4). The deck 38 is located between and supported by a pair of laterally-spaced, generally vertically-extending side plates 46 and 48. The term "lateral" is used herein to mean the direction from one side of the lawn mower to the other, i.e., perpendicular to the forward-rearward direction. Two front wheels 50 rotate about an axle 54 (FIGS. 2 and 3) extending between the side plates 46 and 48 in front of the deck 38, such that each front wheel 50 supports one of the side plates 46 and 48 and the deck 38 for movement over the ground. A rear roller 58 extends between the side plates 46 and 48 and also supports the side plates 46 and 48 and the deck 38 for movement over the ground. The roller 58 is behind the deck 38 and extends across substantially the entire width of the deck 38. The roller 58 resists scalping and stripes the grass.

The deck 38 is mounted on the side plates 46 and 48 such that the height of the deck 38 relative to the ground is adjustable. In the illustrated construction, the deck 38 includes spaced deck plates 66 and 68 (FIGS. 3 and 5) extending upwardly adjacent the side plates 46 and 48, respectively. The upper end of each side plate 46 or 48 has thereon (see FIG. 2) generally horizontal, inwardly-extending ears 69 and 70, with the ear 69 adjacent the front of the side plate and the ear 70 adjacent the rear of the side plate. Fixed to the ears 69 and 70 of each side plate 46 or 48 is an elongated plate member 71 having outwardly-extending ears 72 and 73 respectively secured to the ears 69 and 70 by suitable means such as bolts or screws 74. Each side plate 46 or 48 and the corresponding plate member 71 has therein (see FIGS. 4 and 6) a series of holes 76. Each of the deck plates 66 and 68 has therein several vertically-spaced series of holes 78. Bolts 80 extending through holes 76 in the side plates 46 and 48 and in the plate members 71 and through holes 78 in the deck plates 66 and 68 secure the deck 38 to the side plates 46 and 48. The height of the deck 38 is adjusted by changing the holes 78 in the deck plates 66 and 68 and/or the holes in the side plates 46 and 48 and in the plate members 71 through which the bolts 80 extend.

A single spindle 84 (FIG. 4) is mounted for rotation about a generally vertical axis within the space 42 defined by the deck 38. The spindle 84 is driven by a hydraulic motor 88 on top of the deck 38. The above-mentioned pump supplies hydraulic fluid to the motor 88. It should be understood that other means could be used to drive the spindle 84.

A set of cutting blades is mounted on the spindle 84 for rotation therewith. In the illustrated construction, as shown in FIGS. 3 and 4, each blade set includes a lower, leading blade 92 and an upper, trailing blade 96. The leading blade 92 has a leading cutting edge and an upwardly angled trailing edge or lift. Preferably, the lift of the leading blade 92 is angled upwardly at an angle of approximately forty-five degrees. The trailing blade 96 has a leading cutting edge for cutting clippings deflected upwardly by the lift of the leading blade 92. The blades are preferably identical to those disclosed in U.S. patent application Ser. No. 08/787,383, filed Jan. 22, 1997, titled "ROTARY LAWN MOWER MULCHING DECK" and assigned to the assignee hereof. In alternative embodiments of the invention, different blade arrangements can be employed.

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Each of the deck assemblies 34 is mounted on the frame 12 by a generally L-shaped, horizontally-extending lifting arm 112, such that each deck assembly is mounted on its own lifting arm 112. The lifting arm 112 has (see FIGS. 2 and 3) a laterally-extending inner leg 116 with an inner end connected to the frame 12 for pivotal movement about a generally horizontal axis 120 extending in the forward-rearward direction. The arm 112 also has an outer leg 124 extending in the forward-rearward direction. A cross member 128 is mounted on the outer end of the outer leg 124 for pivotal movement about a generally vertical axis 132 and about a generally horizontal axis 136 extending in the forward-rearward direction. Each of the opposite, laterally-spaced ends of the cross member 128 has thereon (see FIGS. 2, 3, 5 and 6) a downwardly and slightly rearwardly extending arm 140. The lower end of one arm 140 is connected to the side plate 46 for pivotal movement about a generally horizontal, laterally-extending axis 144 adjacent the forward ends of the side plates 46 and 48. The lower end of the other arm 140 is connected to the side plate 48 for pivotal movement about the axis 144.

A hydraulic assembly 148 (partially shown only in FIG. 5) connected between the arm 112 and the frame 12 pivots the arm about the axis 120 for lifting and lowering the deck 38. When the deck is lowered for cutting, the hydraulic assembly allows the lifting arm to "float" thereby allowing the deck 38 to move vertically relative to the frame 12. The connection of the deck 38 to the arm 112 via the cross member 128 allows the deck 38 to pivot relative to the frame 12 about the three mutually perpendicular axes 132, 136 and 144. This mounting arrangement enables the deck 38 to adjust to undulating terrain, thereby substantially avoiding scalping.

It should be understood that the lawn mower 10 could have only two or more than three cutting decks in the front row, and only one or more than two cutting decks in the rear row. Also, other arrangements could be used to mount the decks on the frame 12.

Various features of the invention are set forth in the following claims.

What is claimed is:

1. A gang-type rotary lawn mower comprising
  - a frame supported by wheels for movement over the ground,
  - a power source which is mounted on the frame and which drives at least two of the wheels,
  - an operator's seat mounted on the frame,
  - a steering system enabling the operator to steer the lawn mower,
  - at least two side-by-side front rotary cutting deck assemblies mounted on the frame, the front deck assemblies defining a gap between adjacent front deck assemblies, and
  - at least one rear rotary cutting deck assembly mounted on the frame behind the front deck assemblies, each rear deck assembly being aligned with a respective gap between adjacent front deck assemblies,
  - each of the front and rear deck assemblies including a single-spindle cutting deck defining a downwardly opening space, a single spindle mounted for rotation about a generally vertical axis within the space, and at least one cutting blade mounted on the spindle for rotation therewith.
2. A gang-type rotary lawn mower comprising:
  - a frame supported by front and rear wheels for movement over the ground,

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a power source which is mounted on said frame and which drives at least two of said wheels,

an operator's seat mounted on said frame,

a steering system enabling the operator to steer said lawn mower,

at least one front rotary cutting deck assembly mounted on said frame in front of said front wheels;

at least one rear rotary cutting deck assembly mounted on said frame behind said front deck assemblies and between said front and rear wheels; and

each of said front and rear deck assemblies including a deck defining a downwardly opening space, at least one cutting blade mounted on a spindle for rotation therewith and at least one roller supporting said deck for movement over the ground, said roller extending substantially across the entire width of said deck.

3. A lawn mower as set forth in claim 2 wherein each deck assembly is connected to said frame by a respective lifting arm operable to lift the associated deck assembly relative to said frame, such that each of said deck assemblies is connected by its own lifting arm to said frame.

4. A lawn mower as set forth in claim 2 wherein each of said front and rear deck assemblies includes a pair of laterally-spaced, generally vertically-extending side plates having forward ends, a first front wheel supporting one of said side plates for movement over the ground, and a second front wheel supporting the other of said side plates for movement over the ground, wherein said roller extends between said side plates and supports said side plates for movement over the ground, wherein the associated deck is located between said side plates and in front of said roller and is mounted on said side plates such that the height of said deck relative to the ground is adjustable by changing the position of said deck relative to said side plates.

5. A lawn mower as set forth in claim 2 wherein each deck assembly also includes a hydraulic motor which is mounted on said deck and which is drivably connected to said spindle.

6. A lawn mower as set forth in claim 2 wherein each deck assembly includes a set of cutting blades mounted on said spindle for rotation therewith, said set of blades including a lower, leading blade having a leading cutting edge and an upwardly angled trailing edge, and an upper, trailing blade having a leading cutting edge for cutting clippings deflected upwardly by said upwardly angled trailing edge of said leading blade, said trailing blade extending at a non-perpendicular angle relative to said leading blade so that clippings coming off said trailing edge of said leading blade are cut immediately by said trailing blade before said clippings start swirling around within said space.

7. A lawn mower as set forth in claim 2 wherein at least two front rotary cutting deck assemblies are mounted on said

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frame in a side-by-side relationship defining a gap between adjacent front deck assemblies.

8. A lawn mower as set forth in claim 7 wherein at least one rear deck assembly is aligned with said gap.

9. A lawn mower as set forth in claim 2 wherein each of said front and rear deck assemblies is pivotable relative to said frame about three mutually perpendicular axes.

10. A gang-type rotary lawn mower comprising:

a frame supported by front and rear wheels for movement over the ground;

a power source which is mounted on said frame and which drives at least two of said wheels;

an operator's seat mounted on said frame;

a steering system enabling the operator to steer said lawn mower;

at least two front rotary cutting deck assemblies mounted to said frame in front of said front wheels and in a side-by-side relationship, wherein each of said front cutting deck assemblies defines a front cutting path; and

at least one rear rotary cutting deck assembly being mounted on said frame behind said front deck assemblies, said rear rotary cutting deck assembly defining a rear cutting path extending laterally to overlap a portion of each of said front cutting paths, wherein each of said front and rear deck assemblies has at least one cutting blade mounted on a spindle for rotation therewith and at least one roller to support each of said deck assemblies for movement over the ground, said roller extending substantially across the entire width of said cutting path.

11. A lawn mower as set forth in claim 10 wherein each deck assembly is connected to said frame by a respective lifting arm operable to lift the associated deck assembly relative to said frame, such that each of said deck assemblies is connected by its own lifting arm to said frame.

12. A lawn mower as set forth in claim 10 wherein each of said front and rear deck assemblies includes a pair of laterally-spaced, generally vertically-extending side plates having forward ends, a first front wheel supporting one of said side plates for movement over the ground, and a second front wheel supporting the other of said side plates for movement over the ground, wherein said roller extends between said side plates and supports said side plates for movement over the ground, wherein the associated deck is located between said side plates and in front of said roller and is mounted on said side plates such that the height of said deck relative to the ground is adjustable by changing the position of said deck relative to said side plates.

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## **EXHIBIT 66**

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(12) **United States Patent**  
**Bednar et al.**

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(45) **Date of Patent:** **Jan. 8, 2002**

(54) **GANG-TYPE ROTARY LAWN MOWER WITH MULTIPLE REAR ROLLERS**

(75) Inventors: **Richard D. Bednar, Johnson; Randal S. Knurr, Waterford, both of WI (US)**

(73) Assignee: **Textron Inc., Providence, RI (US)**

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(22) Filed: **Aug. 22, 2000**

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(51) Int. Cl.<sup>7</sup> ..... **A01D 34/66**

(52) U.S. Cl. .... **56/6; 56/13.6**

(58) Field of Search ..... **56/6, 7, 13.6, 13.7, 56/13.8, 255, 295, DIG. 3, DIG. 9, DIG. 14**

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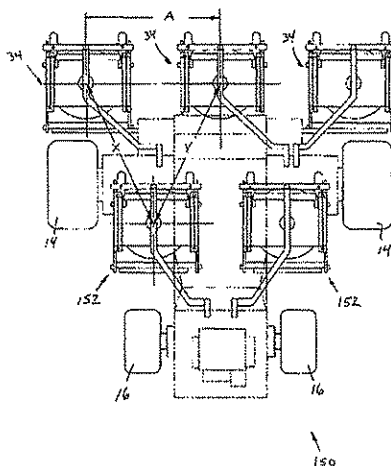
Primary Examiner—Robert E. Pezzuto

(74) Attorney, Agent, or Firm—Harness, Dickey & Pierce PLC

(57) **ABSTRACT**

A gang-type rotary lawn mower including a frame supported by wheels for movement over the ground, a power source which is mounted on the frame and which drives at least two of the wheels, an operator's seat mounted on the frame, a steering system enabling the operator to steer the lawn mower, at least two side-by-side front rotary cutting deck assemblies mounted on the frame, the front deck assemblies defining a gap between adjacent front deck assemblies, and at least one rear rotary cutting deck assembly mounted on the frame behind the front deck assemblies, each rear deck assembly being aligned with a respective gap between adjacent front deck assemblies, each of the front and rear deck assemblies including a single-spindle mulching deck defining a downwardly opening space, a single spindle mounted for rotation about a generally vertical axis within the space, and at least one cutting blade mounted on the spindle for rotation therewith.

27 Claims, 18 Drawing Sheets





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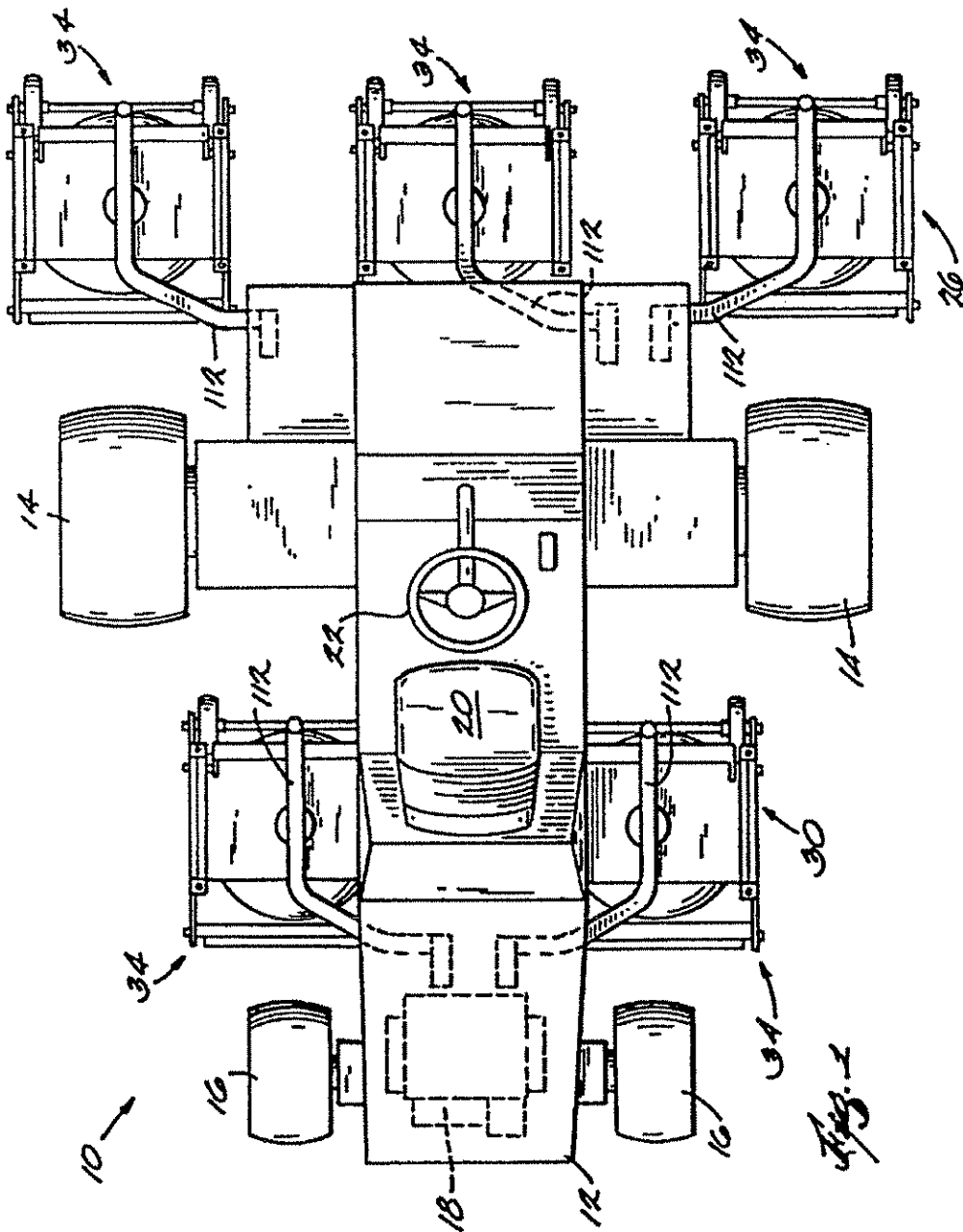
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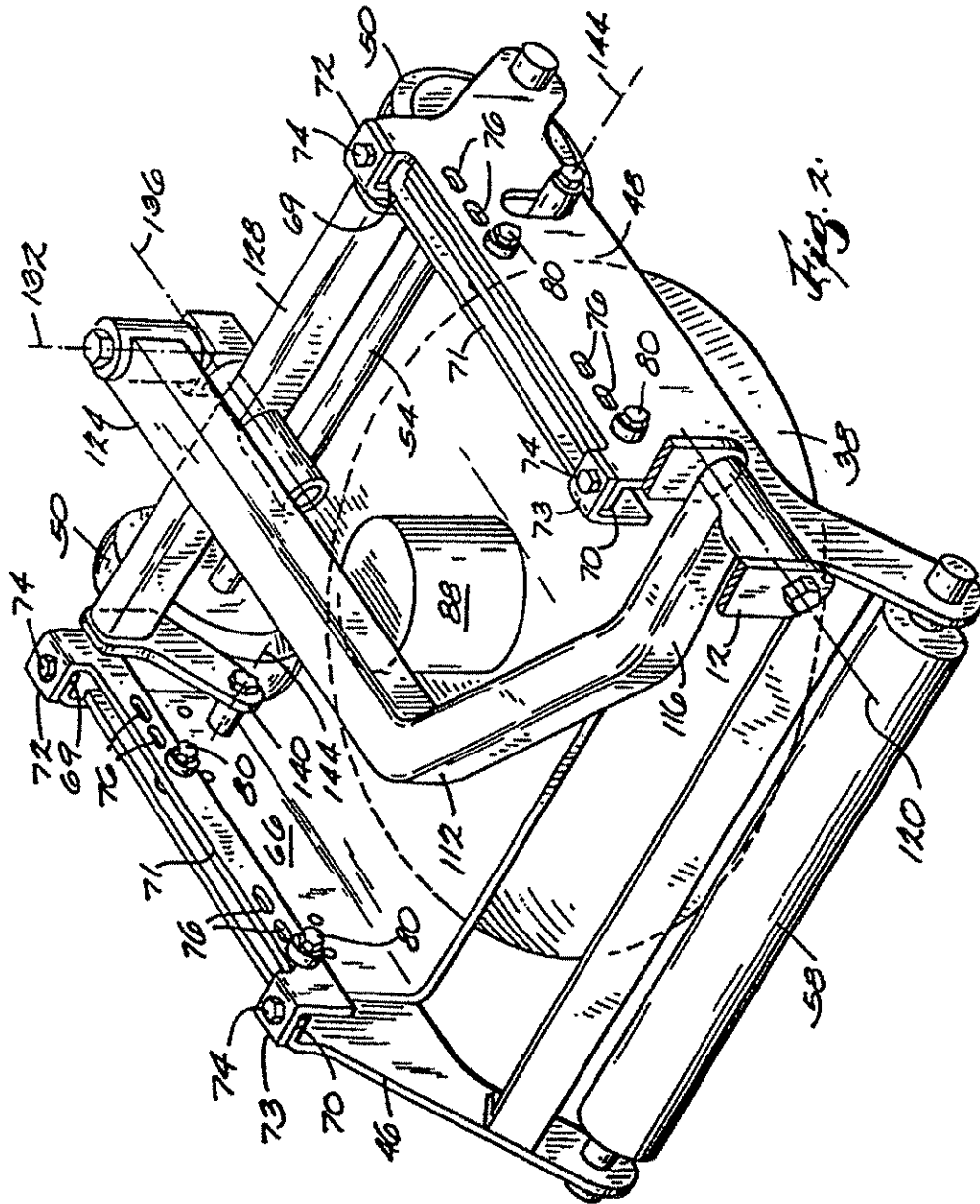
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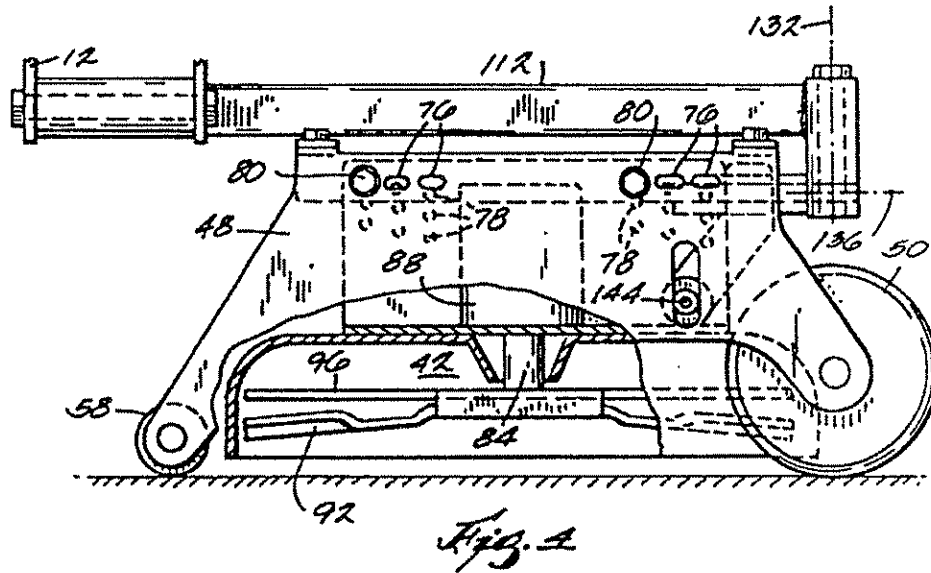
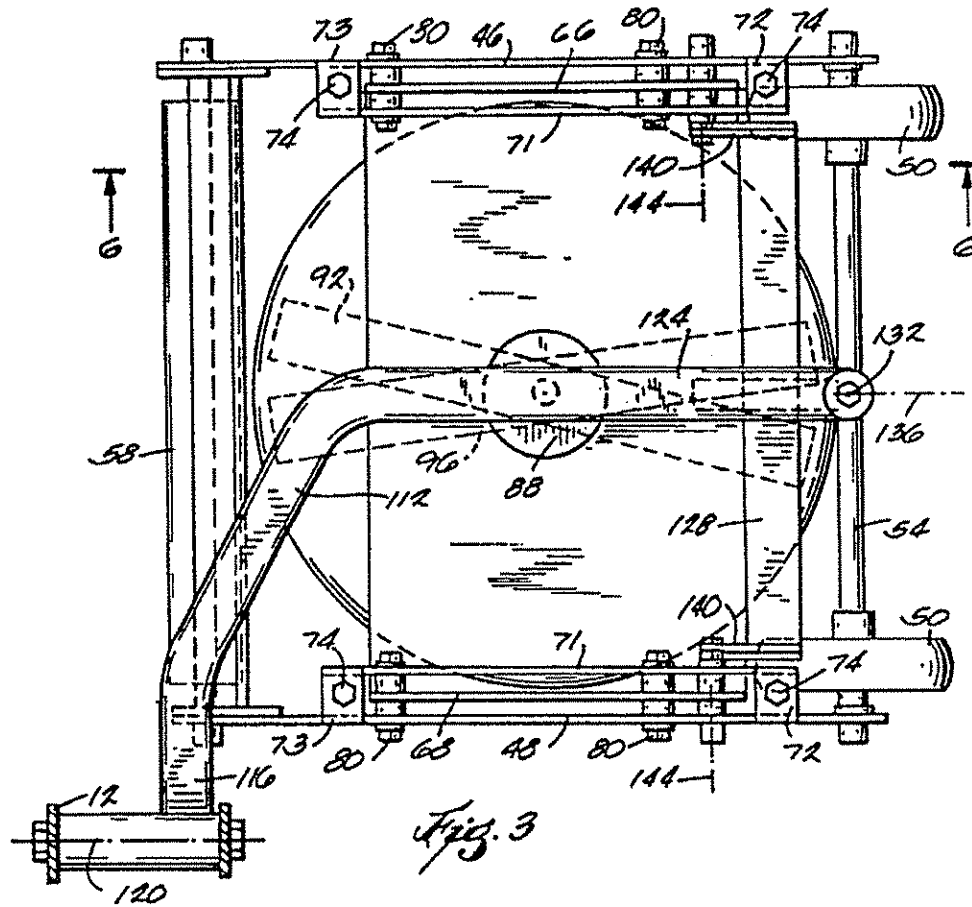


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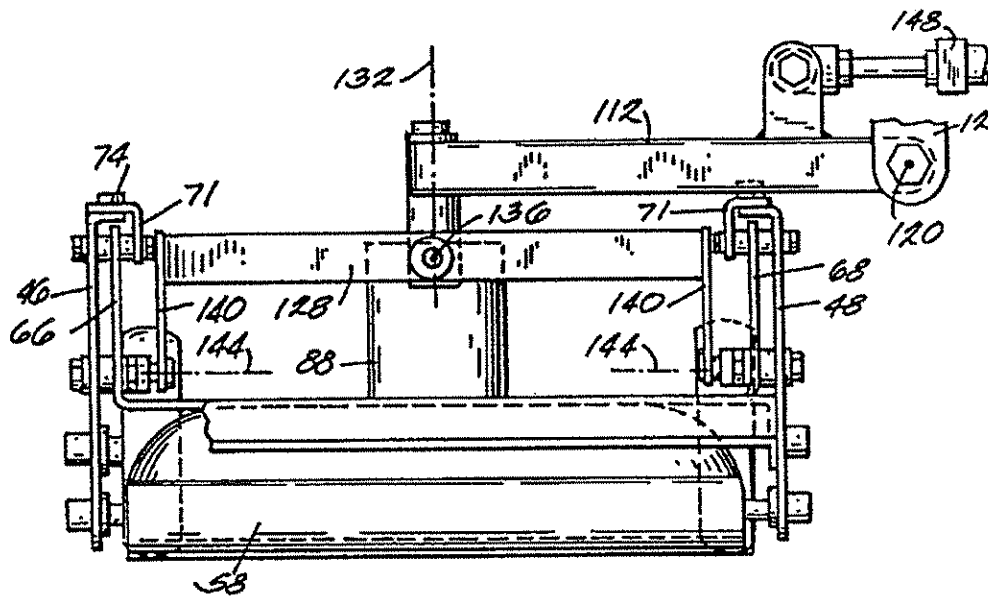


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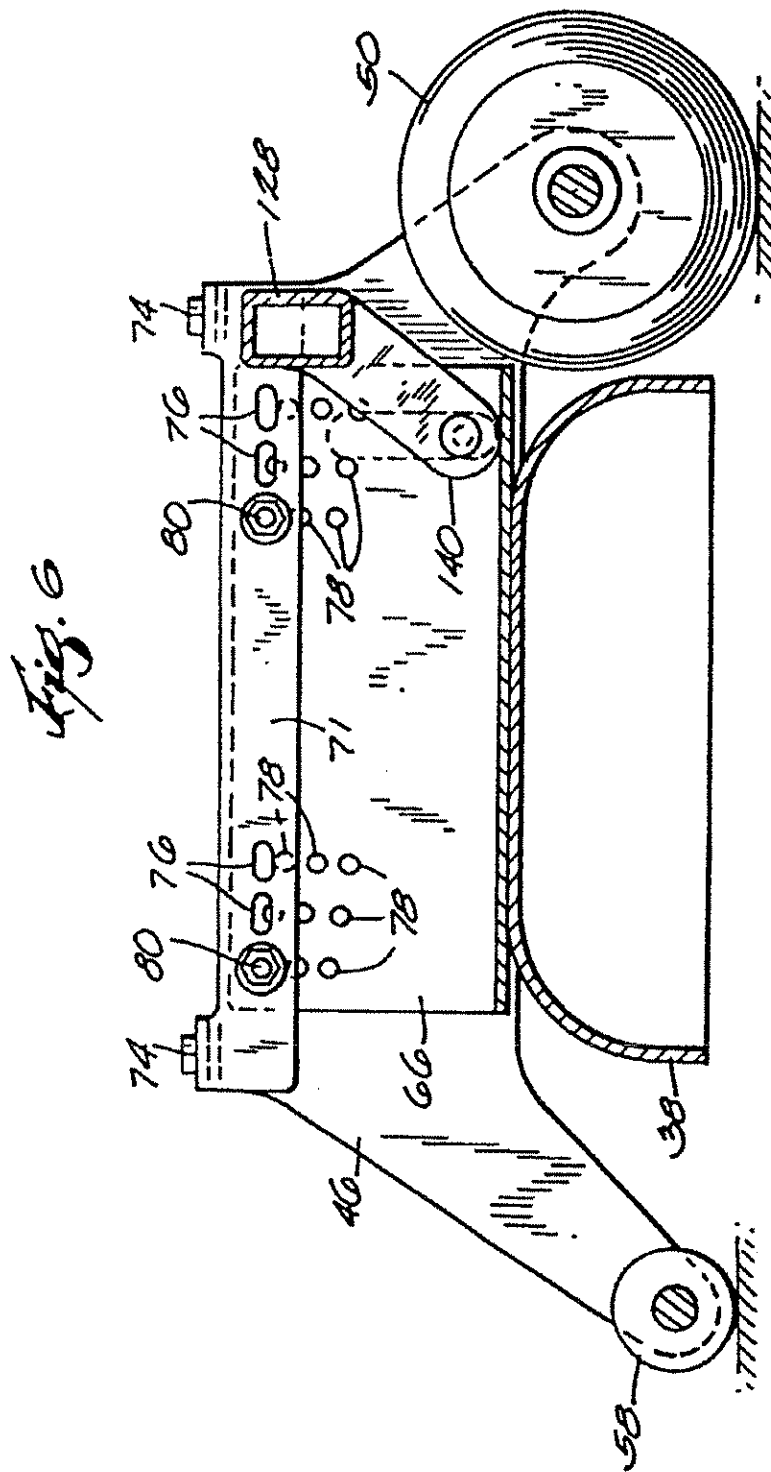
*Fig. 5*

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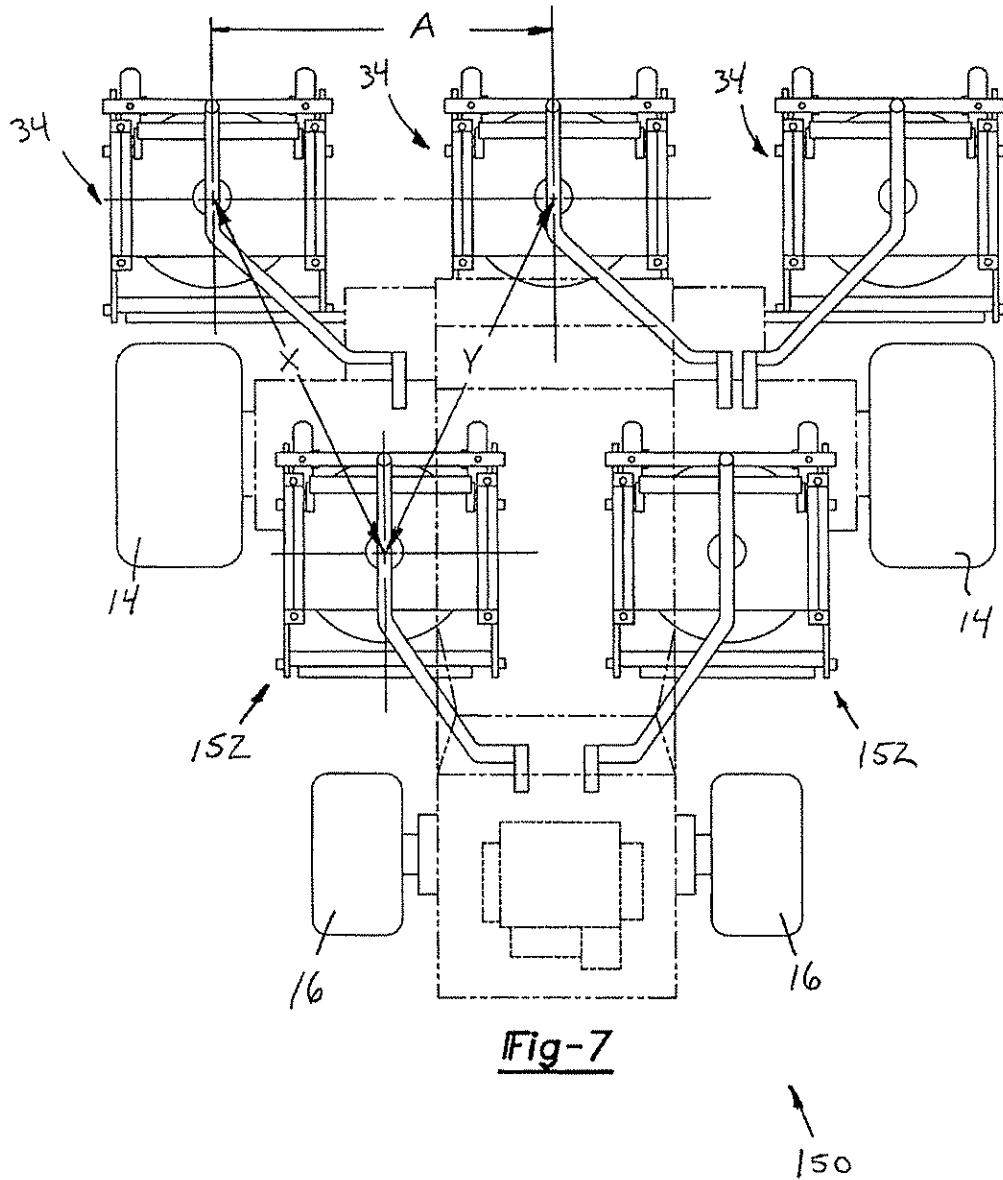


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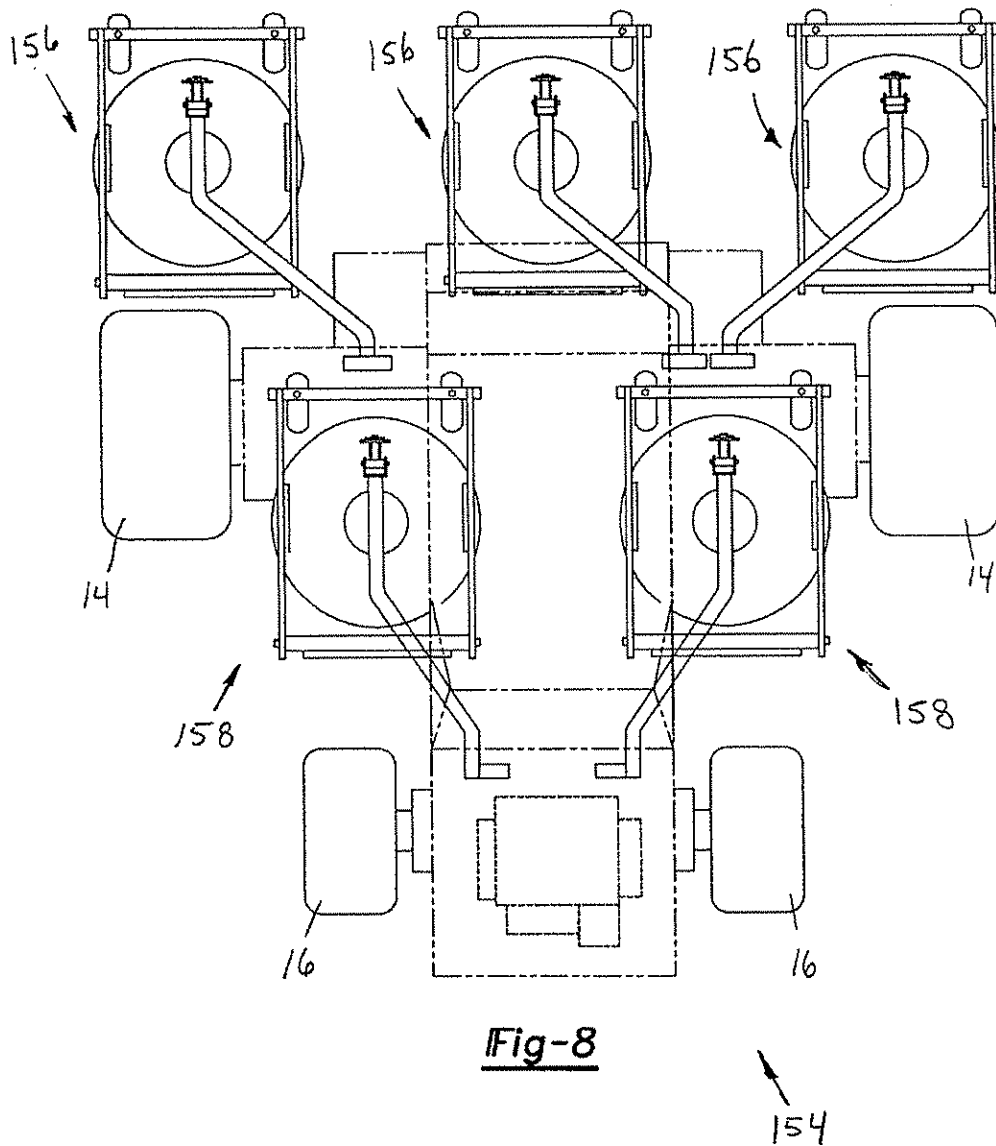


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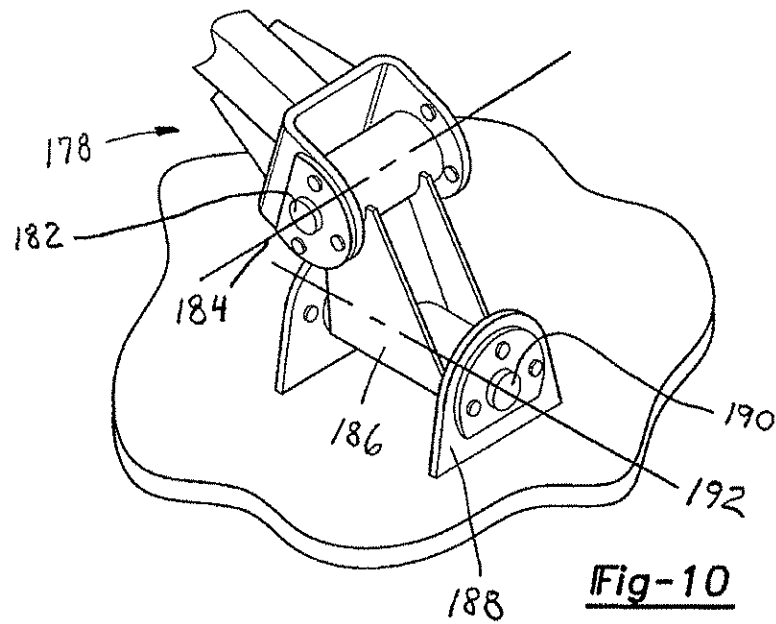
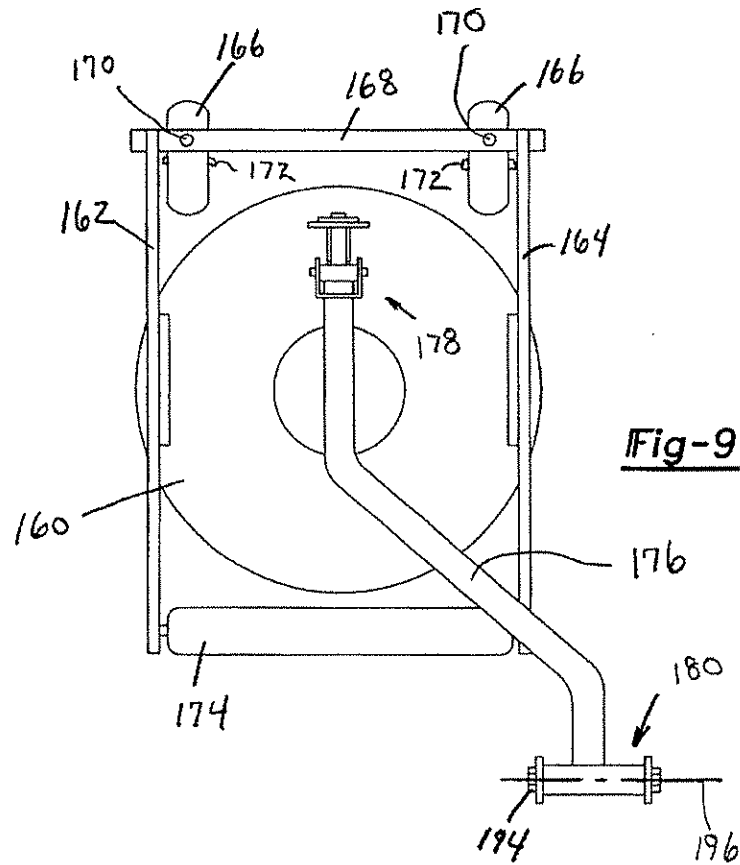


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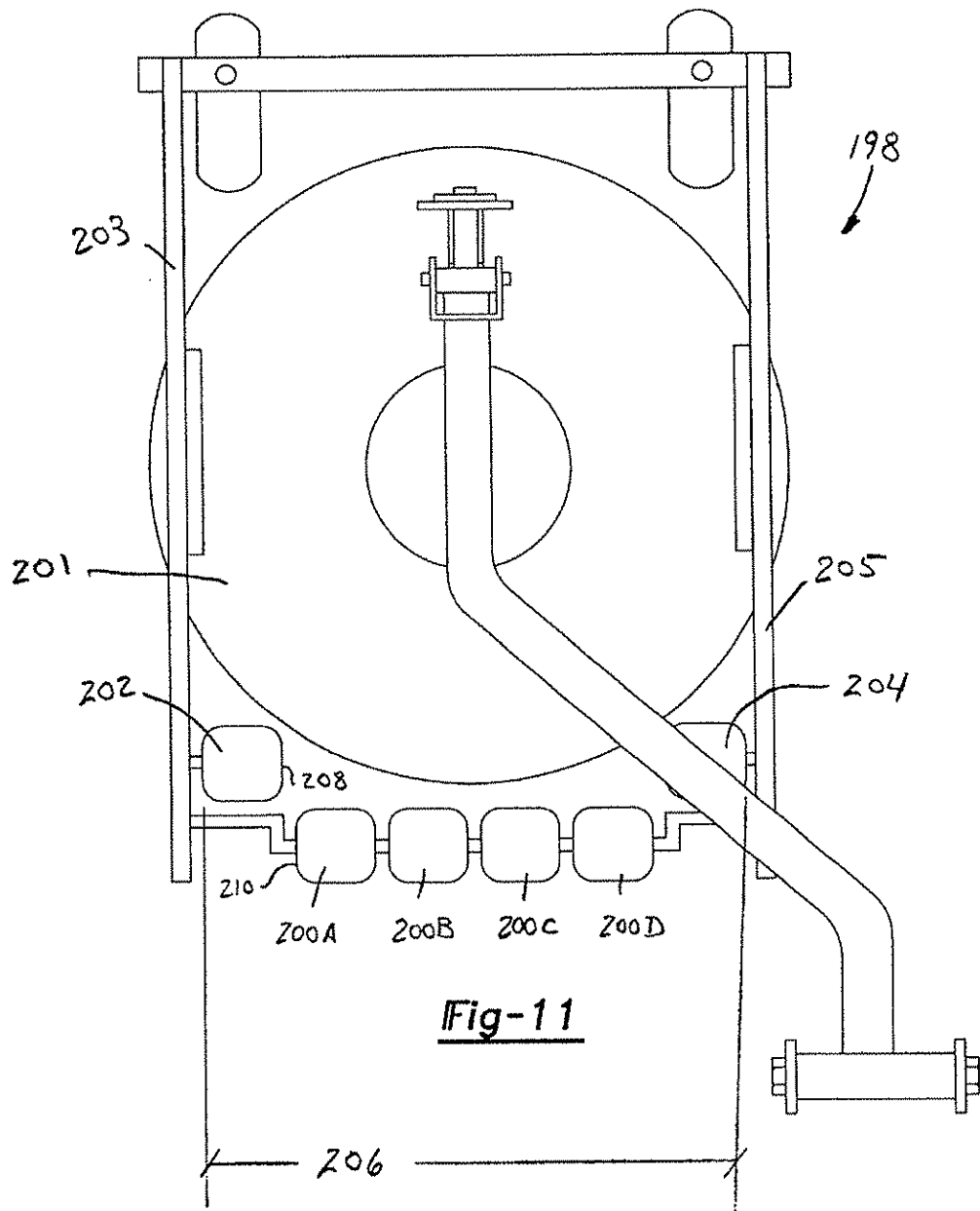


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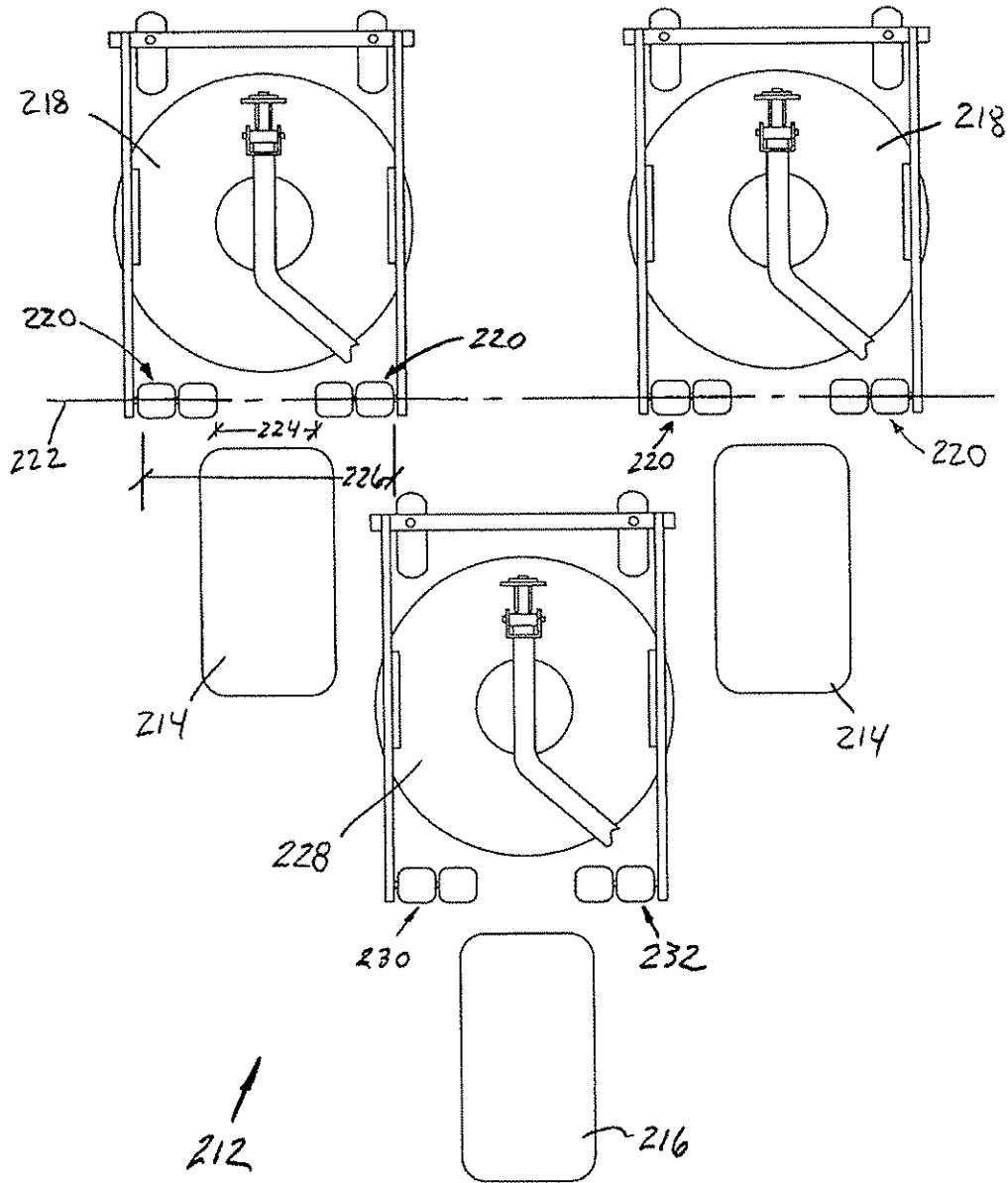


Fig-12



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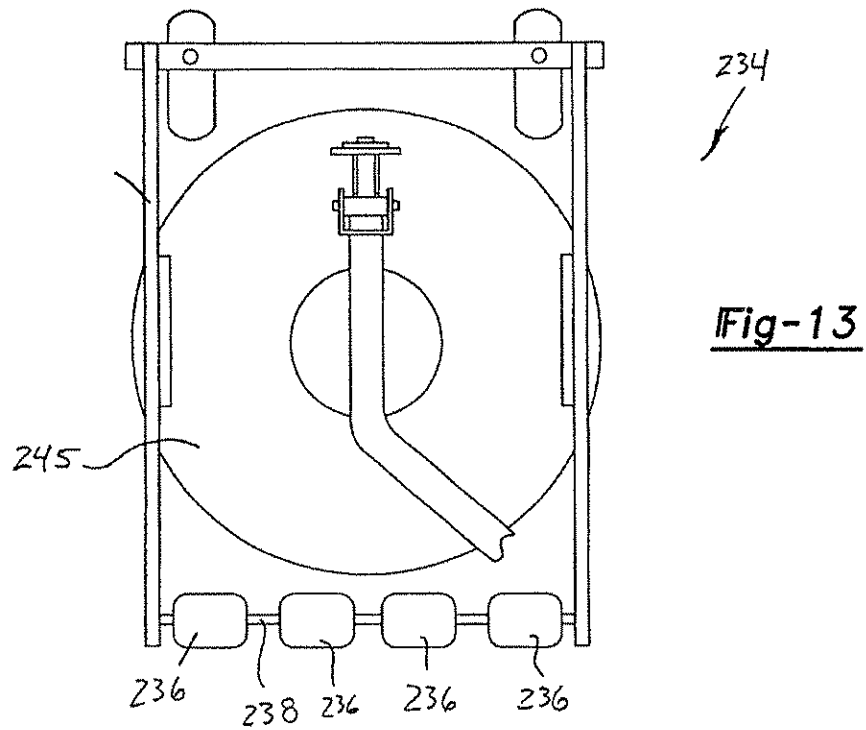
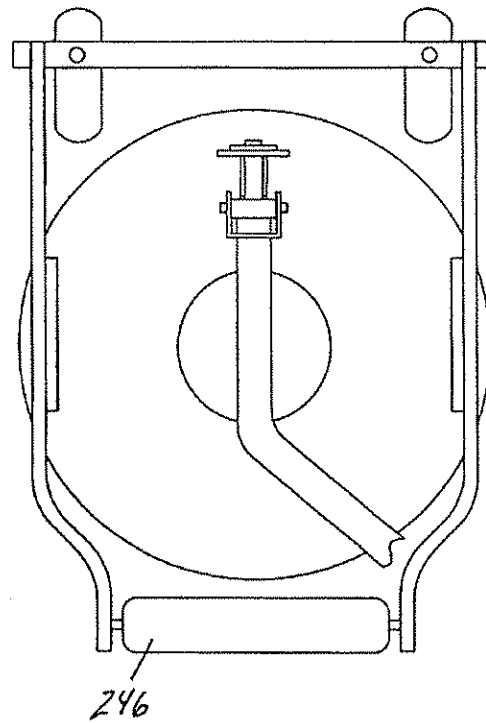


Fig-14

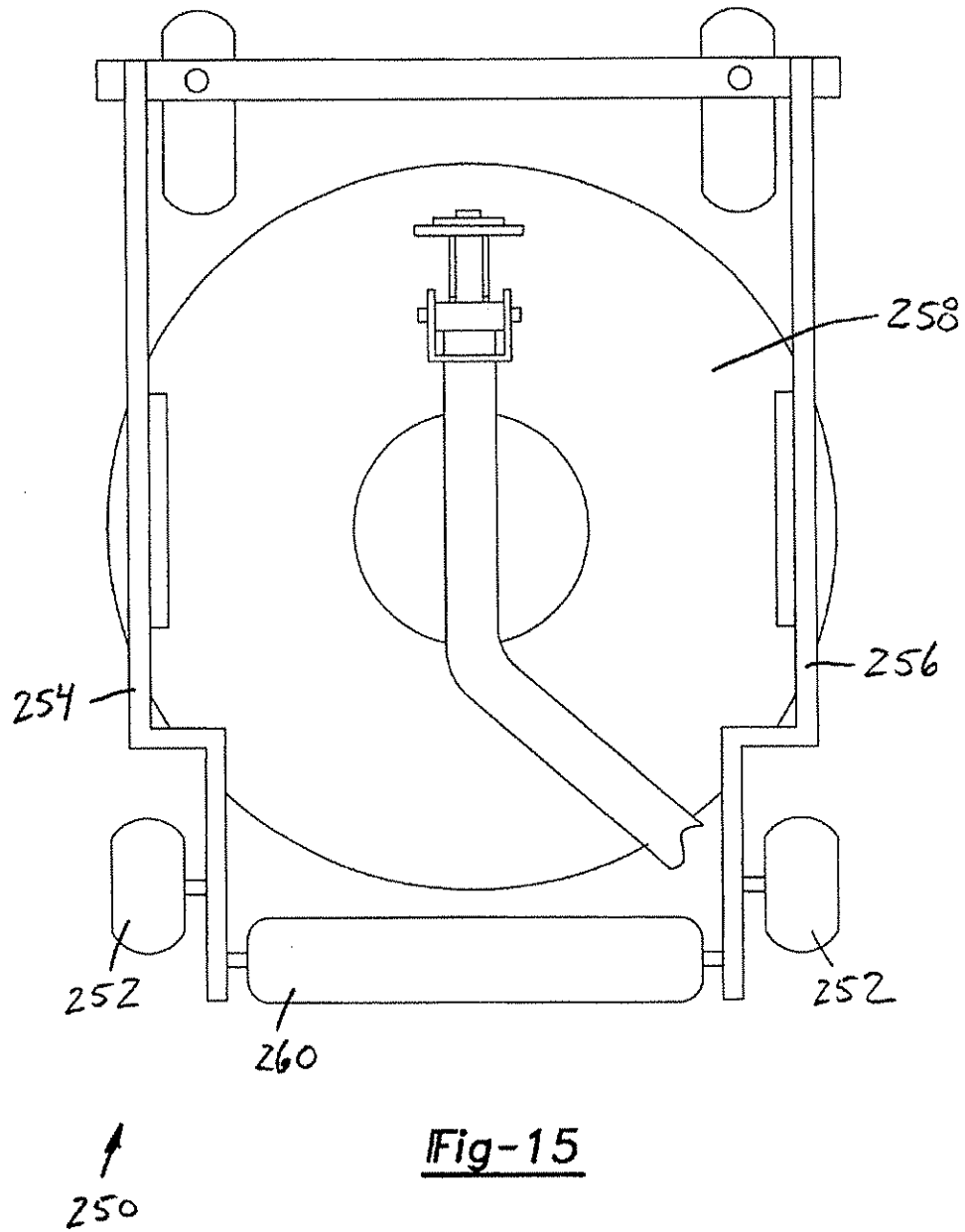


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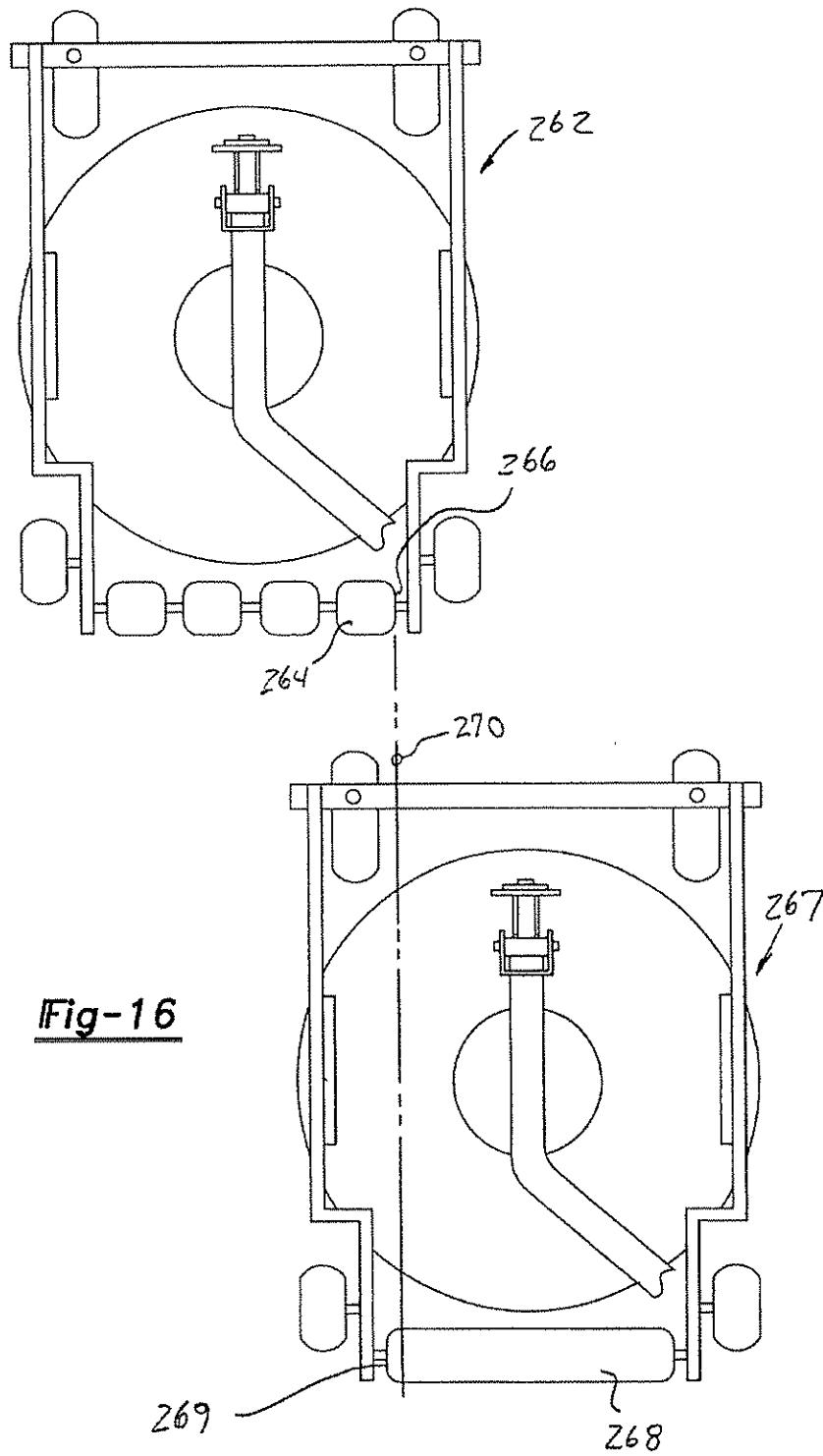


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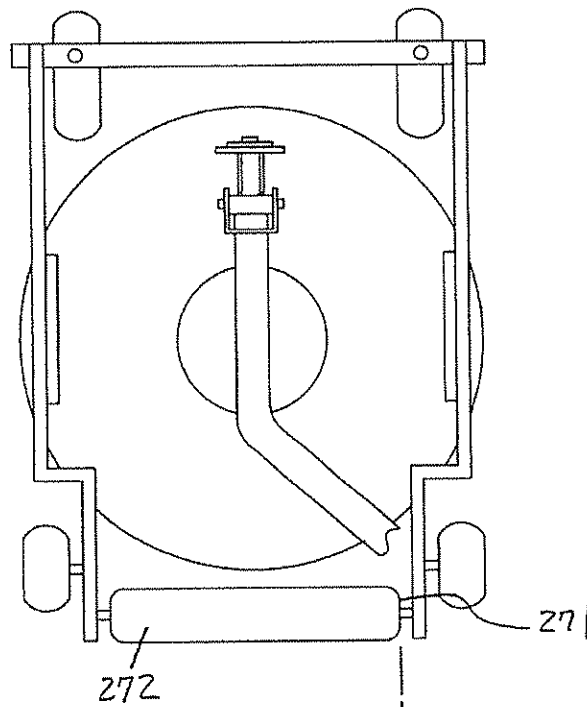
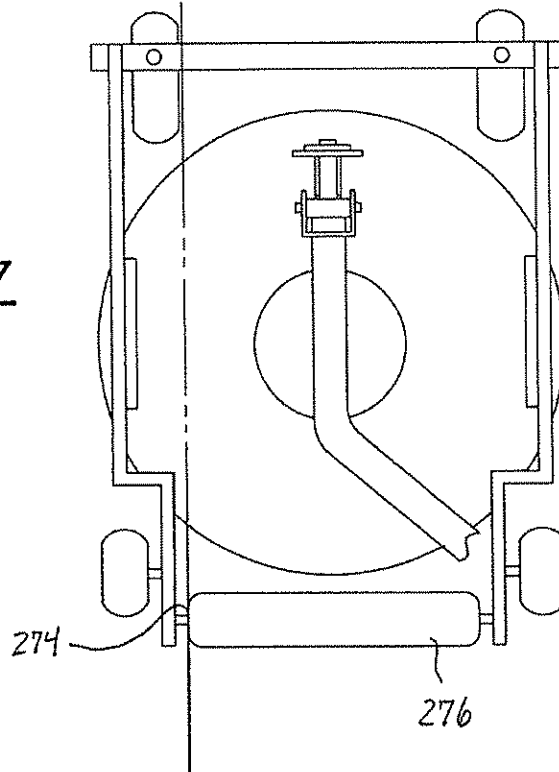


Fig-17



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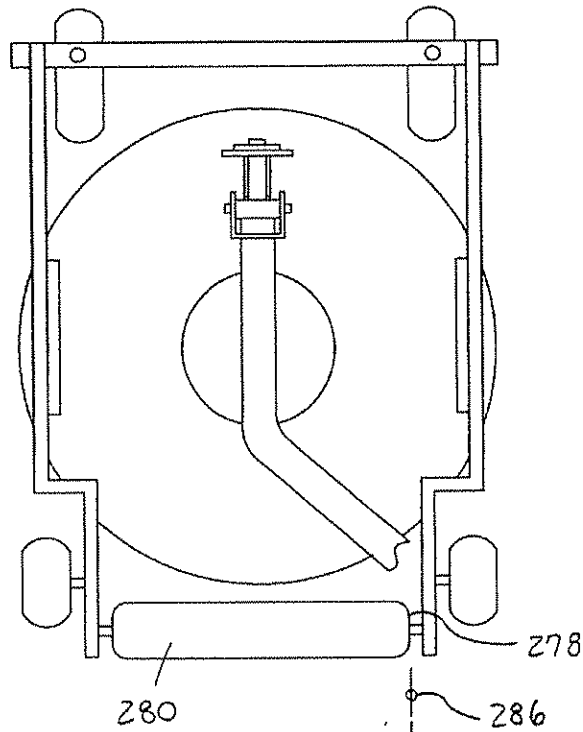
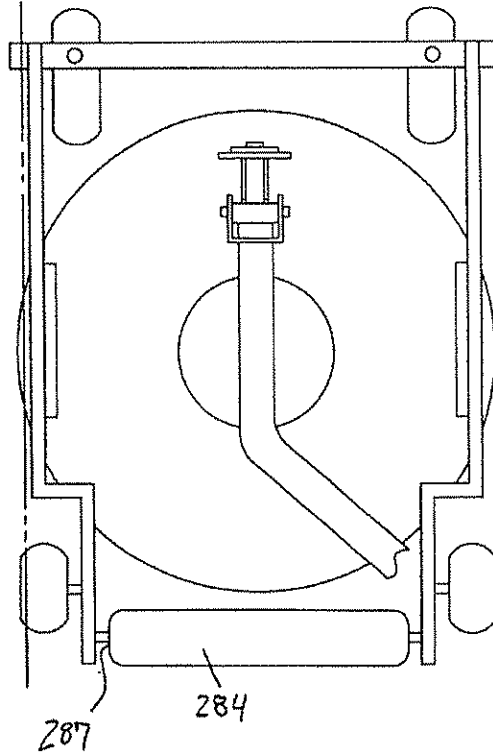


Fig-18

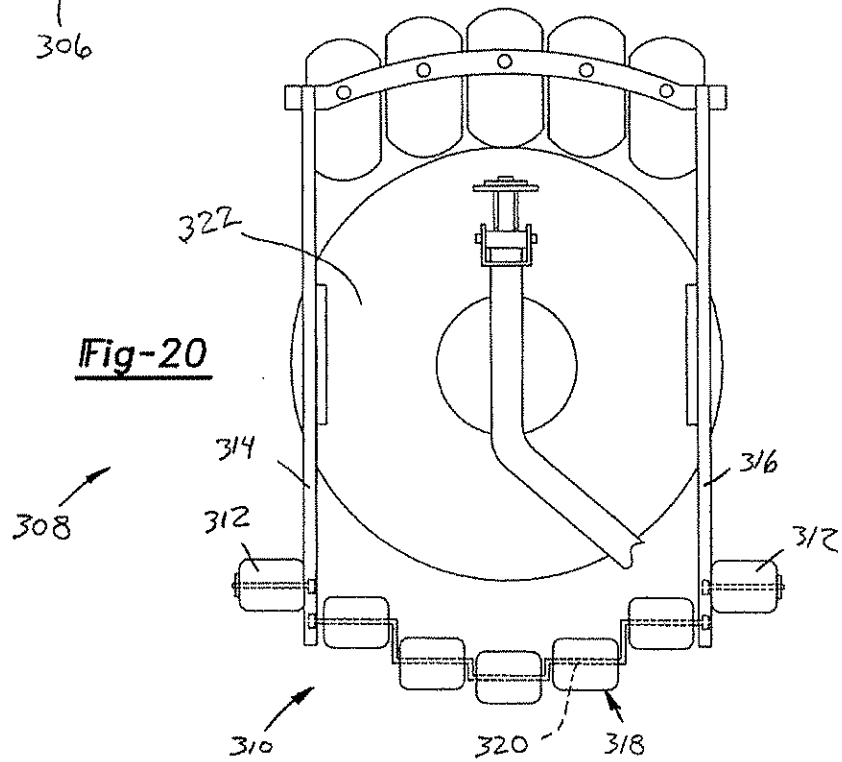
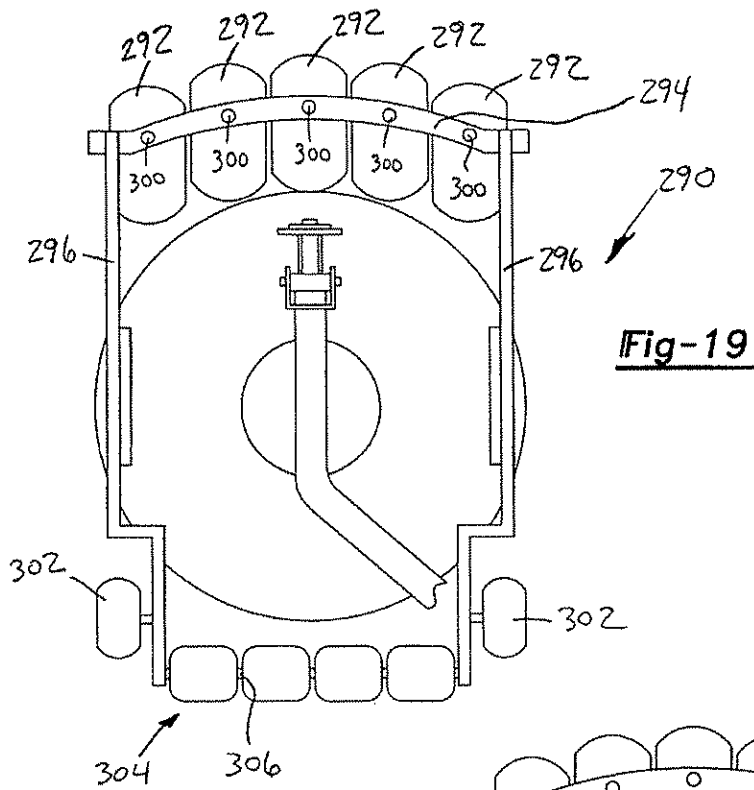


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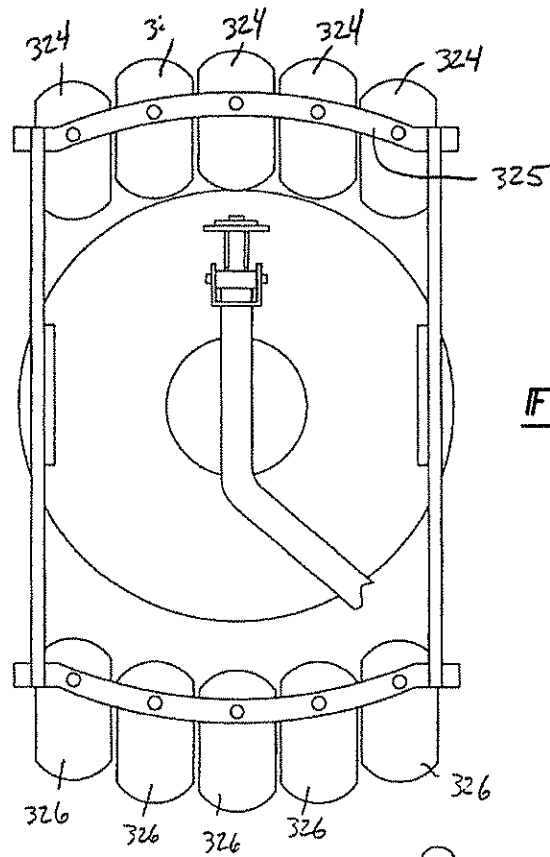
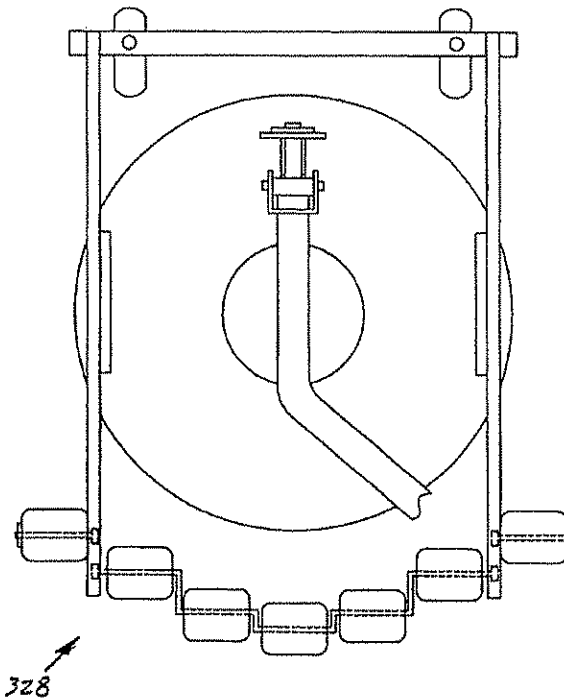


Fig-21

Fig-22



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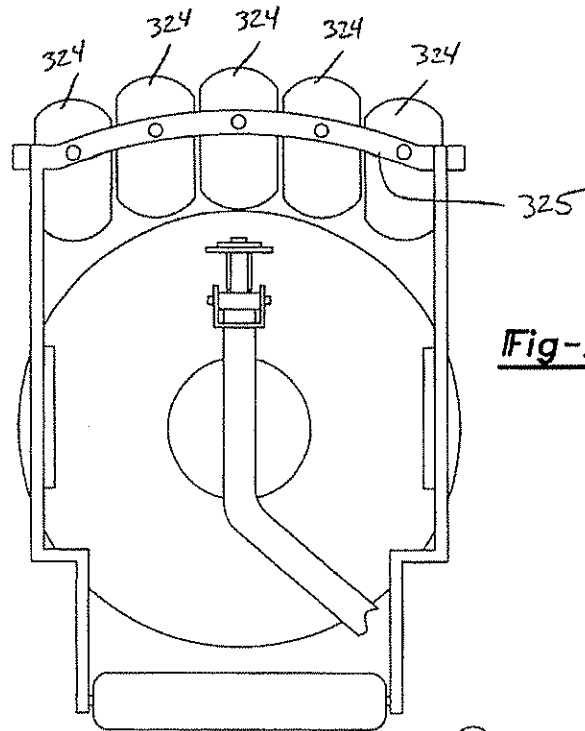
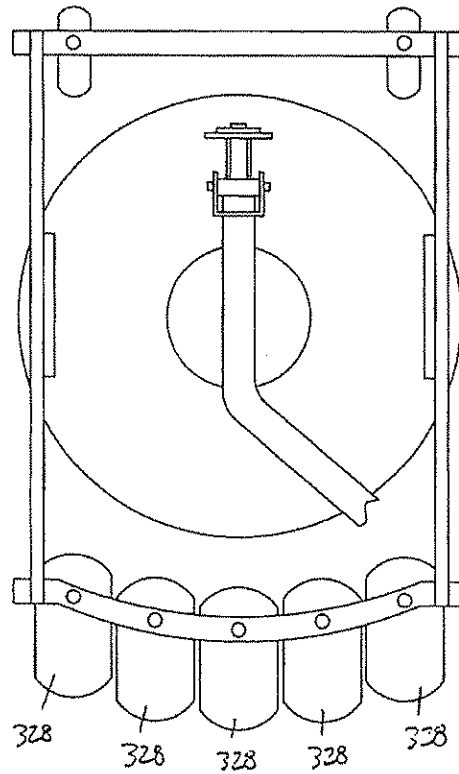


Fig-23

Fig-24





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# GANG-TYPE ROTARY LAWN MOWER WITH MULTIPLE REAR ROLLERS

## RELATED APPLICATIONS

This patent application is a continuation-in-part of U.S. Ser. No. 09/546,145, filed Apr. 10, 2000, which is a continuation of U.S. Ser. No. 08/794,141, filed Feb. 3, 1997, now U.S. Pat. No. 6,047,530, issued Apr. 11, 2000.

## BACKGROUND OF THE INVENTION

The invention relates to rotary lawn mowers and to gang-type lawn mowers. Historically, reel mowers have been used to cut golf course roughs. It is generally recognized that rotary mowers are better suited for cutting tall grass, where scalping is not a problem, while reel mowers are better for shorter cutting. A gang of reels can be either attached directly to the frame on which the operator rides, or pulled behind a tractor. Pull-behind or tow-behind rotary gangs are also known. These can be driven either by a power takeoff or by a separate engine. Tow-behind gangs, whether reel or rotary, are generally undesirable for cutting a golf course rough because close trimming is difficult. Thus, rotary mowers have not been used to cut golf course roughs, which require close trimming and the ability to cut undulating terrain at a relatively short length.

## SUMMARY OF THE INVENTION

The invention provides a gang-type rotary lawn mower suitable for cutting a golf course rough. This is a tremendous improvement over the known prior art, because a rotary mower typically requires substantially less maintenance than a reel mower. The lawn mower has single-spindle cutting decks attached directly to the frame on which the operator rides, with a front row of two or more cutting decks in front of the front wheels, and with a rear row of one or more cutting decks between the front and rear wheels. The invention also provides an improved arrangement for mounting a rotary cutting deck on a lawn mower frame. Each deck is mounted on its own lifting arm so that the deck can move vertically relative to the frame and can pivot relative to the frame about three mutually perpendicular axes.

More particularly, the invention provides a gang-type rotary lawn mower comprising a frame supported by front and rear wheels, an operator's seat mounted on the frame, at least two side-by-side front cutting deck assemblies mounted on the frame in front of the front wheels, and at least one rear cutting deck assembly mounted on the frame behind the front wheels and in front of the rear wheels. Each of the front and rear deck assemblies includes a pair of laterally-spaced, generally vertically-extending side plates, front wheels supporting the side plates for movement over the ground, and a rear roller extending between the side plates and supporting the side plates for movement over the ground. Each deck assembly also includes a single-spindle cutting deck located between the side plates and in front of the roller, the deck being mounted on the side plates such that the height of the deck relative to the ground is adjustable. The roller extends across substantially the entire width of the deck. The roller resists scalping and stripes the grass, both of which are aesthetically desirable.

Each deck assembly is connected to the frame by a generally L-shaped, horizontally-extending lifting arm operable to lift the deck assembly relative to the frame. Each deck assembly is connected to the frame by its own lifting

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arm. Each lifting arm has an inner end pivotally connected to the frame. A cross member is mounted on the outer end of the lifting arm for pivotal movement about a generally vertical axis and about a generally horizontal axis extending in the forward-rearward direction. One end of the cross member is connected to one of the deck assembly side plates for pivotal movement about a generally horizontal, laterally-extending axis adjacent the forward ends of the side plates, and the other end of the cross member is connected to the other side plate for pivotal movement about the same axis.

This construction enables the lawn mower to cut the undulating terrain of a golf course rough and to be controlled for close trimming. Also, as mentioned above, the lawn mower requires much less maintenance than the reel mowers historically used to cut a golf course rough.

Other features and advantages of the invention will become apparent to those skilled in the art upon review of the following detailed description, claims and drawings.

## BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a top plan view of a lawn mower embodying the invention;

FIG. 2 is a perspective view of a cutting deck assembly;

FIG. 3 is a top plan view of the cutting deck assembly;

FIG. 4 is a side elevational view of the cutting deck assembly;

FIG. 5 is a rear elevational view of the cutting deck assembly;

FIG. 6 is a view taken along line 6—6 in FIG. 3;

FIG. 7 is a top plan view of another embodiment of the present invention;

FIG. 8 is a top plan view of another embodiment of the present invention;

FIG. 9 is a top plan view of a cutter assembly of the present invention;

FIG. 10 is a perspective view of a lifting arm and cutting deck interconnection;

FIG. 11 is a top plan view of an alternate embodiment cutter deck assembly;

FIG. 12 is a top plan view of a three-wheeled lawn mower embodiment of the present invention;

FIG. 13 is a top plan view of a cutter assembly having a segmented roller assembly;

FIG. 14 is a top plan view of another embodiment of a cutter assembly;

FIG. 15 is a top plan view of another cutter assembly embodiment;

FIG. 16 is a partial top plan view of an alternate embodiment lawn mower;

FIG. 17 is a partial top plan view of another alternate embodiment lawn mower;

FIG. 18 is a partial top plan view of another alternate embodiment lawn mower;

FIG. 19 is a top plan view of a cutter assembly having a plurality of front caster wheels;

FIG. 20 is a top plan view of a cutter assembly having a "V" shaped rear roller assembly;

FIG. 21 is a top plan view of a cutter assembly having a plurality of front and rear caster wheels;

FIG. 22 is a top plan view of another embodiment of a cutter assembly;

FIG. 23 is a top plan view of another embodiment of a cutter assembly; and

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FIG. 24 is a top plan view of another cutter assembly embodiment.

Before certain embodiments of the invention are explained in detail, it is to be understood that the invention is not limited in its application to the details of the construction and the arrangements of components set forth in the following description or illustrated in the drawings. The invention is capable of other embodiments and of being practiced or being carried out in various ways. Also, it is understood that the phraseology and terminology used herein is for the purpose of description and should not be regarded as limiting.

#### DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

A lawn mower 10 embodying the invention is illustrated in FIG. 1. Except as described below, the lawn mower 10 is identical to the lawn mower disclosed in U.S. patent application Ser. No. 08/787,384, filed Jan. 22, 1997, titled "PARALLEL-SERIES FOUR-WHEEL-DRIVE HYDRAULIC CIRCUIT FOR A RIDING LAWN MOWER" and assigned to the assignee hereof. The lawn mower 10 comprises a frame 12 (partially shown in FIGS. 2-5) supported by front wheels 14 and rear wheels 16 for movement over the ground. While the illustrated lawn mower 10 is rear-steering and has four-wheel drive, it should be understood that the invention is applicable to front-steering or two-wheel-drive lawn mowers.

The lawn mower 10 further comprises a power source 18 supported by the frame 12. The power source may be any type known in the art, such as a gasoline-powered, internal-combustion engine. The engine drives a hydraulic pump (not shown) that supplies hydraulic fluid to hydraulic motors (not shown) drivingly connected to the wheels 14 and 16. The lawn mower 10 further comprises an operator's seat 20, and a conventional steering system, including a steering wheel 22, enabling the operator to steer the lawn mower 10. In the illustrated construction, the steering system is hydraulic and is connected to the rear wheels 16 to steer the lawn mower 10.

The lawn mower 10 further comprises front and rear rows 26 and 30, respectively, of cutting deck assemblies 34. More particularly, in the illustrated construction, the lawn mower 10 has three side-by-side front cutting deck assemblies 34 in front of the front wheels 14, and two rear cutting deck assemblies 34 behind the front wheels 14 and in front of the rear wheels 16. As is known in the art, each rear deck assembly 34 is aligned with the gap between two adjacent front deck assemblies 34.

Each of the cutting deck assemblies 34 includes (see FIGS. 2-5) a single-spindle mulching deck 38 defining a downwardly opening space 42 (FIG. 4). The deck 38 is located between and supported by a pair of laterally-spaced, generally vertically-extending side plates 46 and 48. The term "lateral" is used herein to mean the direction from one side of the lawn mower to the other, i.e., perpendicular to the forward-rearward direction. Two front wheels 50 rotate about an axle 54 (FIGS. 2 and 3) extending between the side plates 46 and 48 in front of the deck 38, such that each front wheel 50 supports one of the side plates 46 and 48 and the deck 38 for movement over the ground. A rear roller 58 extends between the side plates 46 and 48 and also supports the side plates 46 and 48 and the deck 38 for movement over the ground. The roller 58 is behind the deck 38 and extends across substantially the entire width of the deck 38. The roller 58 resists scalping and stripes the grass.

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The deck 38 is mounted on the side plates 46 and 48 such that the height of the deck 38 relative to the ground is adjustable. In the illustrated construction, the deck 38 includes spaced deck plates 66 and 68 (FIGS. 3 and 5) extending upwardly adjacent the side plates 46 and 48, respectively. The upper end of each side plate 46 or 48 has thereon (see FIG. 2) generally horizontal, inwardly-extending ears 69 and 70, with the ear 69 adjacent the front of the side plate and the ear 70 adjacent the rear of the side plate. Fixed to the ears 69 and 70 of each side plate 46 or 48 is an elongated plate member 71 having outwardly-extending ears 72 and 73 respectively secured to the ears 69 and 70 by suitable means such as bolts or screws 74. Each side plate 46 or 48 and the corresponding plate member 71 has therein (see FIGS. 4 and 6) a series of holes 76. Each of the deck plates 66 and 68 has therein several vertically-spaced series of holes 78. Bolts 80 extending through holes 76 in the side plates 46 and 48 and in the plate members 71 and through holes 78 in the deck plates 66 and 68 secure the deck 38 to the side plates 46 and 48. The height of the deck 38 is adjusted by changing the holes 78 in the deck plates 66 and 68 and/or the holes in the side plates 46 and 48 and in the plate members 71 through which the bolts 80 extend.

A single spindle 84 (FIG. 4) is mounted for rotation about a generally vertical axis within the space 42 defined by the deck 38. The spindle 84 is driven by a hydraulic motor 88 on top of the deck 38. The above-mentioned pump supplies hydraulic fluid to the motor 88. It should be understood that other means could be used to drive the spindle 84.

A set of cutting blades is mounted on the spindle 84 for rotation therewith. In the illustrated construction, as shown in FIGS. 3 and 4, each blade set includes a lower, leading blade 92 and an upper, trailing blade 96. The leading blade 92 has a leading cutting edge and an upwardly angled trailing edge or lift. Preferably, the lift of the leading blade 92 is angled upwardly at an angle of approximately forty-five degrees. The trailing blade 96 has a leading cutting edge for cutting clippings deflected upwardly by the lift of the leading blade 92. The blades are preferably identical to those disclosed in U.S. patent application Ser. No. 08/787,382, filed Jan. 22, 1997, titled "ROTARY LAWN MOWER MULCHING DECK" and assigned to the assignee hereof. In alternative embodiments of the invention, different blade arrangements can be employed.

Each of the deck assemblies 34 is mounted on the frame 12 by a generally L-shaped, horizontally-extending lifting arm 112, such that each deck assembly is mounted on its own lifting arm 112. The lifting arm 112 has (see FIGS. 2 and 3) a laterally-extending inner leg 116 with an inner end connected to the frame 12 for pivotal movement about a generally horizontal axis 120 extending in the forward-rearward direction. The arm 112 also has an outer leg 124 extending in the forward-rearward direction. A cross member 128 is mounted on the outer end of the outer leg 124 for pivotal movement about a generally vertical axis 132 and about a generally horizontal axis 136 extending in the forward-rearward direction. Each of the opposite, laterally-spaced ends of the cross member 128 has thereon (see FIGS. 2, 3, 5 and 6) a downwardly and slightly rearwardly extending arm 140. The lower end of one arm 140 is connected to the side plate 46 for pivotal movement about a generally horizontal, laterally-extending axis 144 adjacent the forward ends of the side plates 46 and 48. The lower end of the other arm 140 is connected to the side plate 48 for pivotal movement about the axis 144.

A hydraulic assembly 148 (partially shown only in FIG. 5) connected between the arm 112 and the frame 12 pivots

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the arm about the axis 120 for lifting and lowering the deck 38. When the deck is lowered for cutting, the hydraulic assembly allows the lifting arm to "float," thereby allowing the deck 38 to move vertically relative to the frame 12. The connection of the deck 38 to the arm 112 via the cross member 128 allows the deck 38 to pivot relative to the frame 12 about the three mutually perpendicular axes 132, 136 and 144. This mounting arrangement enables the deck 38 to adjust to undulating terrain, thereby substantially avoiding scalping.

With reference to FIG. 7, an alternate lawn mower embodiment is depicted at reference numeral 150. It should be appreciated that lawn mower 150 includes common components and functions substantially similarly to lawn mower 10. Accordingly, similar components will be identified with like reference numerals. Lawn mower 150 preferably includes three side-by-side front cutting deck assemblies 34 in front of the wheels 14 and two rear cutting deck assemblies 152 positioned between the front wheels 14 and in front of the rear wheels 16. Each of the rear cutting deck assemblies 152 is positioned within the gap between two adjacent front deck assemblies 34. Rear deck assemblies 152 are substantially similar to cutting deck assemblies 34. However, cutting deck assemblies 152 are positioned adjacent one another between the front wheels. The placement of rear cutting deck assemblies 152 closer to front deck assemblies 34 allows for a reduction in lawn mower wheel base and overall length. Accordingly, lawn mower weight may be decreased while maneuverability is increased. Specifically, by closely packaging rear deck assemblies 152 with front deck assemblies 34 the turning radius of the lawn mower may be decreased without introducing strips of uncut grass. By way of example and without limitation, the distance between any two adjacent cutting deck centers, X and Y, varies between 1 and 2.5 units of cutting deck diameter, D. Additionally, as forward cutting deck assemblies are spaced apart a distance A, the ratio of distance X to distance A (X/A) and distance Y to distance A (Y/A) varies between 1 and 1.6.

FIG. 8 depicts another lawn mower embodiment 154 having three forward cutting deck assemblies 156 and two rear cutting assemblies 158. Forward cutting assemblies 156 are aligned side-by-side spaced apart from one another forward of front wheels 14. Rear cutting deck assemblies 158 are also aligned side-by-side and spaced apart from one another. Rear cutting deck assemblies 158 are positioned between front wheels 14 in similar fashion to lawn mower 150 previously described.

With reference to FIGS. 9 and 10, each of the cutting deck assemblies 156 and 158 includes a single spindle mulching deck 160 defining a downwardly opening space. Deck 160 is supported by a pair of laterally spaced, generally vertically extending side plates 162 and 164. Two caster wheels 166 are pivotally coupled to a cross-arm 168 extending between side plates 162 and 164, such that each caster wheel 166 supports one of the side plates 162 and 164 and the deck 160 for movement over the ground. Each of the caster wheels 166 is coupled to cross-arm 168 via a caster shaft 170. Accordingly, each of caster wheels 166 may rotate about an axle shaft 172 and also pivot about caster shaft 170 when the vehicle is turning. A continuous, unitary roller 174 extends between side plates 162 and 164 and also supports side plates 162 and 164 and deck 160 for movement over the ground. In this embodiment, roller 174 is positioned behind deck 160 and extends substantially across the entire width of deck 160.

Each of the deck assemblies includes a lifting arm 176 to pivotally interconnect each of the deck assemblies with

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frame 12. Each lifting arm 176 includes a first end 178 pivotally coupled to deck 160 and a second end 180 pivotally coupled to frame 12. Specifically, first end 178 cooperates with a pin 182 to define an axis of rotation 184 extending laterally across deck 160 perpendicular to the forward-rearward direction of travel. Pin 182 rotatably couples second end 180 to a bracket 186. Bracket 186 is in turn pivotally coupled to a pair of stantions 188 extending from deck 160. A second pin 190 rotatably interconnects bracket 186 and stantions 188 for rotation about an axis 192 longitudinally extending in the forward-rearward direction of the mower 154.

Second end 180 of lifting arm 176 includes a third pin 194 pivotally interconnecting lifting arm 176 with frame 12. Pin 194 defines an axis 196 laterally extending across mower 154. As earlier described with reference to FIG. 5, a hydraulic assembly 148 connected between lifting arm 176 and frame 12 pivots the arm about axis 196 for lifting and lowering deck 160.

An alternate embodiment cutter deck assembly 198 is depicted in FIG. 11. A segmented first roller 200 is positioned behind a deck 201 laterally extending a distance less than the width of deck 201. Segmented roller 200 includes a plurality of roller segments 200A, 200B, 200C and 200D. It should be appreciated that segmented first roller 200 may include any number of roller segments without departing from the scope of the present invention. A second roller 202 is positioned forward of first roller 200. Second roller 202 is coupled to a side plate 203 and generally aligned with an outside edge of deck 201. A third roller 204 is aligned laterally with second roller 202 and positioned forward of first roller 200. Third roller 204 is coupled to a side plate 205 and generally aligned with an outside edge of deck 201. First roller 200, second roller 202 and third roller 204 are positioned to define a substantially uninterrupted rolling path 206 to provide an aesthetically pleasing striping of the grass. Second roller 202 and third roller 204 may be sized such that a portion of each of these rollers overlaps first roller 200. Alternatively, an inner edge 208 of second roller 202 may be aligned with an outer edge 210 of first roller 200 to provide the substantially uninterrupted roller path.

With reference to FIG. 12, a three-wheeled mower 212 includes two forward wheels 214 and one rear wheel 216. Two forward cutting deck assemblies 218 are aligned with each of the wheels 214 in the longitudinal (forward-rearward) direction of travel and laterally aligned with each other. Each of cutting deck assemblies 218 includes a pair of segmented rollers 220 aligned along an axis of rotation 222 and laterally spaced apart from one another a predetermined distance 224. Each of the forward wheels 214 is aligned with the space between rollers 220 such that the combination of rollers 220 and wheel 214 form a rolling path 226 to provide the striping effect.

A rear cutting deck assembly 228 is positioned within the gap between forward cutting assemblies 218. Rear cutting deck assembly 228 is preferably laterally centered between forward cutting deck assemblies 218 to assure that all of the grass across the width of mower 212 is cut. In addition, forward cutting deck assemblies 218 are spread apart a distance less than the cutting width of rear cutting deck assembly 228 to further assure a complete width of cut when mower 212 is turning. Rear cutting deck assembly 228 is aligned with rear wheel 216 such that a first roller 230 and a second roller 232 cooperate with rear wheel 216 to stripe the grass.

Another cutting deck assembly is depicted at reference numeral 234 in FIG. 13. Cutting deck assembly 234 includes



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a plurality of separate rollers 236 aligned and rotatably mounted to axle 238. Axle 238 is coupled to a first side plate 242 and a second side plate 244. Accordingly, rollers 236 support the side plates and a deck 245 for movement over the ground. Rollers 236 are preferably axially spaced apart a predetermined distance along axle 238 to provide an alternate striping effect. It should be appreciated that rollers 236 are positioned such that they do not extend substantially across the entire width of a mower deck 245. In similar fashion and in reference to FIG. 14, a single one-piece unitary roller 246 may be incorporated to support the side plates and deck. Roller 246 does not extend the entire width of the mower deck.

As shown in FIG. 15, another embodiment 250 of a cutting deck assembly includes a pair of rear wheels 252 coupled to a pair of side plates 254 and 256, respectively. Rear wheels 252 function to support side plates 254 and 256 along with a mower deck 258 for movement over the ground. Additionally, cutter deck assembly 250 includes a unitary, one-piece roller 260 extending between side plates 254 and 256 a distance less than the entire width of deck 258.

Referring to FIGS. 16-18, each of the forward and rear cutting deck assemblies may be positioned relative to another in a number of ways. Specifically, a forward cutting deck assembly 262 includes a roller 264 having an inboard edge 266 which may be positioned in an overlapping relationship with a rear cutting deck assembly 267 having a roller 268 with an outboard edge 269. As phantom line 270 represents, inboard edge 266 of forward cutting deck assembly 262 overlaps outboard edge 269 of rear cutting deck assembly 267 to create the appearance of one continuous roller stripe.

Similarly, with reference to FIG. 17, an inboard edge 271 of a roller 272 may be longitudinally aligned with an outboard edge 274 of a roller 276. Accordingly, the cutting deck positions depicted in the Figure provide a substantially continuous roller stripe. As shown in FIG. 18, an inboard edge 278 of a roller 280 may be offset from an outboard edge 282 of a roller 284 as depicted by phantom line 286. In this manner, an interrupted stripe is formed in the grass as the rollers pass over.

Another cutting deck embodiment 290 is depicted in FIG. 19. Cutting deck assembly 290 includes a plurality of front caster wheels 292 pivotally coupled to a arcuate cross member 294 interconnecting a first side plate 296 and a second side plate 298. Each of front caster wheels 292 is pivotally coupled to cross member 294 via a caster pin 300. The plurality of caster wheels 292 provide an improved anti-scalp feature such that if any one of the caster wheels were to encounter a raised portion of turf, deck assembly 290 would be lifted to prevent the cutting blade from removing too much grass and scalping the turf. Cutting deck 290 also includes a pair of rear wheels 302 and a rear segmented roller assembly 304. Rear wheels 302 are pivotally coupled to each of the side plates 296 and 298. Each of the segments of segmented rear roller assembly 304 are rotatably coupled and aligned along an axle 306.

FIG. 20 depicts yet another cutting deck assembly 308 having a stepped and segmented rear roller assembly 310. Rear roller assembly 310 includes a pair of outboard rollers 312 coupled to side plates 314 and 316. Rear roller assembly 310 also includes an inboard set of rollers 318 positioned between side plates 314 and 316 and rotatably mounted on a stepped axle shaft 320. Rear roller assembly 310 provides a striped pattern having a width greater than the width of a deck 322.

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FIGS. 21-24 depict additional cutting deck embodiments including various combinations of components previously introduced. Specifically, FIGS. 21 and 23 include a plurality of front caster wheels 324 pivotally mounted to a cross-member 325. The embodiment depicted in FIG. 21 includes a rearwardly mounted plurality of caster wheels 326 in lieu of a rear roller. FIG. 22 includes a "V" shaped offset, segmented roller assembly 328 similar to the assembly shown in FIG. 20 and depicted at reference numeral 310. Finally, FIG. 24 includes a rear plurality of caster wheels 328 similar to those shown in FIG. 21 at numeral 326.

It should be understood that any of the aforementioned lawn mowers may have two or more decks in the front row, and one or more cutting decks in the rear row. Also, other arrangements may be used to mount the decks to frame 12.

Various features of the invention are set forth in the following claims.

What is claimed is:

1. A gang-type rotary lawn mower comprising:

a frame supported by front wheels and at least one rear wheel for movement over the ground;

a power source which is mounted on said frame and which drives at least two of said wheels;

an operator's seat mounted on said frame;

a steering system enabling the operator to steer said lawn mower;

at least two side-by-side front rotary cutting deck assemblies mounted on said frame in front of said front wheels, said front deck assemblies defining a gap between adjacent front deck assemblies; and

at least one rear rotary cutting deck assembly mounted on said frame behind said front deck assemblies and between said front wheels, each rear deck assembly being aligned with a respective gap between adjacent front deck assemblies;

each of said front and rear deck assemblies including a deck defining a downwardly opening space, at least one cutting blade mounted on a spindle for rotation therewith and a first roller supporting said deck for movement over the ground, said first roller extending only partially across the width of said deck.

2. The lawn mower of claim 1 wherein each of said front and rear deck assemblies further includes a second roller positioned in offset relation to said first roller.

3. The lawn mower of claim 2 wherein each of said front and rear deck assemblies further includes a third roller having an axis of rotation aligned with an axis of rotation of said second roller.

4. The lawn mower of claim 3 wherein each of said first, second and third rollers define a rolling path substantially uninterrupted across the width of the deck.

5. The lawn mower of claim 4 wherein said rolling path includes a portion traveled by both of said first and second rollers.

6. The lawn mower of claim 1 wherein each of said front and rear deck assemblies includes a second roller aligned with said first roller and spaced apart therefrom, said first and second rollers positioned on opposite sides of a respective wheel such that a rolling path is defined by said first roller, said second roller and said respective wheel.

7. The lawn mower of claim 6 wherein said rolling path extends substantially across the deck width.

8. The lawn mower of claim 1 wherein said first roller of said at least one front deck assembly defines a rolling path and said first roller of said corresponding at least one rear deck assembly defines a rolling path.

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9. The lawn mower of claim 8 wherein said rolling path defined by said front deck assembly roller overlaps said rolling path defined by said rear deck assembly roller.

10. The lawn mower of claim 8 wherein said rolling path defined by said front deck assembly roller includes an inboard edge aligned with an outboard edge of said rolling path defined by said rear deck assembly roller.

11. The lawn mower of claim 8 wherein said rolling path defined by said front deck assembly roller is spaced apart from said rolling path defined by said rear deck assembly roller.

12. The lawn mower of claim 1 wherein each of said front and rear deck assemblies further includes a pair of rotatable wheels pivotally mounted to said frame.

13. The lawn mower of claim 12 wherein said rotatable wheels are mounted on a caster shaft.

14. The lawn mower of claim 1 further including a lifting arm pivotally interconnecting each of said front deck assemblies to said frame, said lifting arm pivoting about an axis laterally extending across said deck assembly substantially parallel to the ground and perpendicular to the direction of travel.

15. The lawn mower of claim 1 wherein said first roller is a unitary, one-piece roller.

16. The lawn mower of claim 1 wherein said first roller is a segmented roller having a plurality of roller segments.

17. The lawn mower of claim 16 wherein said roller segments are aligned along an axis of rotation.

18. The lawn mower of claim 16 wherein each of said roller segments is positioned in an offset manner from an adjacent one of said roller segments.

19. A cutting deck assembly for a gang-type rotary lawn mower having a frame, the cutting deck assembly comprising:

- a deck defining a downwardly opening space;
- at least one cutting blade mounted on a spindle for rotation therewith;
- a pair of laterally-spaced, generally vertically extending side plates having forward ends;
- a first front wheel supporting one of said side plates for movement over the ground;
- a second front wheel supporting the other of said side plates for movement over the ground;
- a roller extending between said side plates supporting said side plates for movement over the ground, wherein said deck is coupled to said side plates and located in front

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of said roller such that the height of said deck relative to the ground is adjustable by changing the position of said deck relative to said side plates; and

a lifting arm adapted to pivotally interconnect said cutting deck assembly and the frame.

20. The lawn mower of claim 19 wherein said roller is a unitary, one-piece roller.

21. The lawn mower of claim 19 wherein said roller is a segmented roller having a plurality of roller segments.

22. The lawn mower of claim 21 wherein said roller segments are aligned along an axis of rotation.

23. The lawn mower of claim 21 wherein each of said roller segments is positioned in an offset manner from an adjacent one of said roller segments.

24. A gang-type rotary lawn mower comprising:

a frame supported by front wheels and at least one rear wheel for movement over the ground;

a power source which is mounted on said frame and which drives at least two of said wheels;

an operator's seat mounted on said frame;

a steering system enabling the operator to steer said lawn mower;

at least two side-by-side front rotary cutting deck assemblies mounted on said frame in front of said front wheels, said front deck assemblies defining a gap between adjacent front deck assemblies; and

at least one rear rotary cutting deck assembly mounted on said frame behind said front deck assemblies, each rear deck assembly being aligned with a respective gap between adjacent front deck assemblies;

each of said front and rear deck assemblies including a deck defining a downwardly opening space, at least one cutting blade mounted on a spindle for rotation therewith and a first, second and third roller supporting said deck for movement over the ground, said first roller extending only partially across the width of said deck.

25. The lawn mower of claim 24 wherein said first roller and said second roller are positioned in along different axes of rotation.

26. The lawn mower of claim 25 wherein said third roller and said second roller rotate about the same axis of rotation.

27. The lawn mower of claim 26 wherein said second and third rollers are positioned forward of said first roller.

\* \* \* \* \*

## **EXHIBIT 67**

## THE BAYARD FIRM

The Honorable Gregory M. Sleet  
 December 7, 2006  
 Page 6

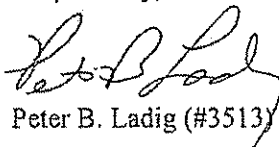
As for element [g], the Court interpreted "deck defining a downwardly opening space" to have its plain and ordinary meaning. Toro's engineers conceded that the terms cutting "deck" and cutting "unit" are interchangeable. Exh. 9 (Moe Dep. Tr. at 58: 20-59: 14 (Q: "So is the cutting unit a subset of the deck or is it vice versa?" A: "The cutting unit is not a subset of the deck. Depending on usage or common usage, deck and cutting unit can be used interchangeably. The deck chamber would be a subset of the cutting unit.")). Toro's product literature, Exh. 12 (Toro 27" Rotary Cutting Deck Operator's Manual) refers to the "deck" as the entire structure. Similarly, Toro's own patent on its accused cutting deck refers to the entire structure as the "deck." Exh. 13 (U.S. Patent 6,470,663 at 4:24-26 ("Cutting deck 2 of this invention has a superstructure of frame 4 on which various elements of cutting deck 2 are carried.")). Toro's engineering drawings show that the cutting deck is 30.174 inches wide, whereas Toro's rear roller is 29.846 inches wide, a difference of only 0.328 inches. Thus, there is no genuine issue of material fact that the Toro "deck [has] a width such that the roller extends across substantially the entire width of the deck."

#### Toro's Failure to Proffer Any Evidence of Inequitable Conduct

Toro's Second Amended Answer (D.I. 56) alleges that certain statements of the inventor in a declaration are contradicted by a so-called Buchanan article and, thus, constitute inequitable conduct. Inequitable conduct requires that the patentee withheld material information from the patent examiner or submitted false material information, with the intent to deceive or mislead the examiner into granting the patent. *Upjohn Co. v. Mova Pharmaceutical Corp.*, 225 F.3d 1306, 1312 (Fed. Cir. 2000). Both materiality and intent to deceive must be proven by clear and convincing evidence. *Id.* "[M]ateriality does not presume intent, which is a separate and essential component of inequitable conduct." *Manville Sales Corp. v. Paramount Sys., Inc.*, 917 F.2d 544, 552 (Fed. Cir. 1990).

The Buchanan article was not material, but moreover Toro has not proffered and cannot proffer any evidence that the inventor of the Textron Patents was even aware of the Buchanan article. This fact is undisputed and dispositive of the defense. Because the inventor had no knowledge of the Buchanan article, there are no genuine issues of material fact that the inventor intended to deceive the Patent Office in his declaration.

Respectfully,



Peter B. Ladig (#3513)

## **EXHIBIT 68**





US006470663B2

(12) **United States Patent**  
Langworthy et al.

(10) Patent No.: **US 6,470,663 B2**  
(45) Date of Patent: **Oct. 29, 2002**

(54) **REAR DISCHARGE ROTARY CUTTING  
DECK FOR MOWER**

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Farmington, MN (US); **Daniel M. Treu**,  
Eagan, MN (US)

(73) Assignee: **The Toro Company**, Minneapolis, MN  
(US)

(\*) Notice: Subject to any disclaimer, the term of this  
patent is extended or adjusted under 35  
U.S.C. 154(b) by 0 days.

(21) Appl. No.: **09/777,618**

(22) Filed: **Feb. 6, 2001**

(65) **Prior Publication Data**

US 2002/0104301 A1 Aug. 8, 2002

(51) Int. Cl.<sup>7</sup> ..... **A01D 34/64**

(52) U.S. Cl. .... **56/320.2**

(58) Field of Search ..... **56/17.5, 320.1,  
56/321.2, 13.3, 13.4-13.8, 202, DIG. 9,  
DIG. 22, 16.7, 255, 295**

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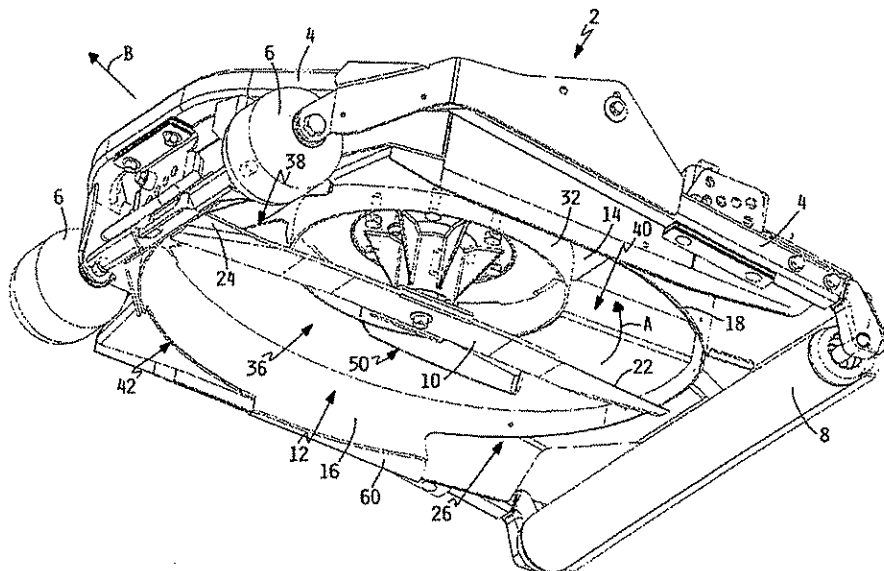
Primary Examiner—Robert E. Pezzuto

(74) Attorney, Agent, or Firm—James W. Miller

(57) **ABSTRACT**

A rotary cutting deck has a rear grass discharge outlet formed by a cut-away portion of the peripheral wall of the cutting chamber located in one or more rear quadrants of the cutting chamber. An annular grass discharge channel is formed between an inner concentric shroud and the peripheral wall of the cutting chamber with the rear grass discharge outlet opening into this channel. A grass deflecting ramp is located within the grass discharge channel with a front end of the ramp located in advance of the entrance to the rear grass discharge outlet and a rear end of the ramp located in one of the rear quadrants of the cutting chamber to be adjacent some portion of the rear discharge outlet. The grass deflecting ramp progressively lowers between its front and rear ends to deflect grass clippings generally downwardly towards the rear discharge outlet. The ramp can have a downwardly extending divider vane to promote more even side-to-side distribution of the grass clippings. A horizontal baffle can be provided on the lower edge of the peripheral wall of the cutting chamber in advance of the rear grass discharge outlet to minimize side streaking or dribbling of grass clippings.

**21 Claims, 6 Drawing Sheets**

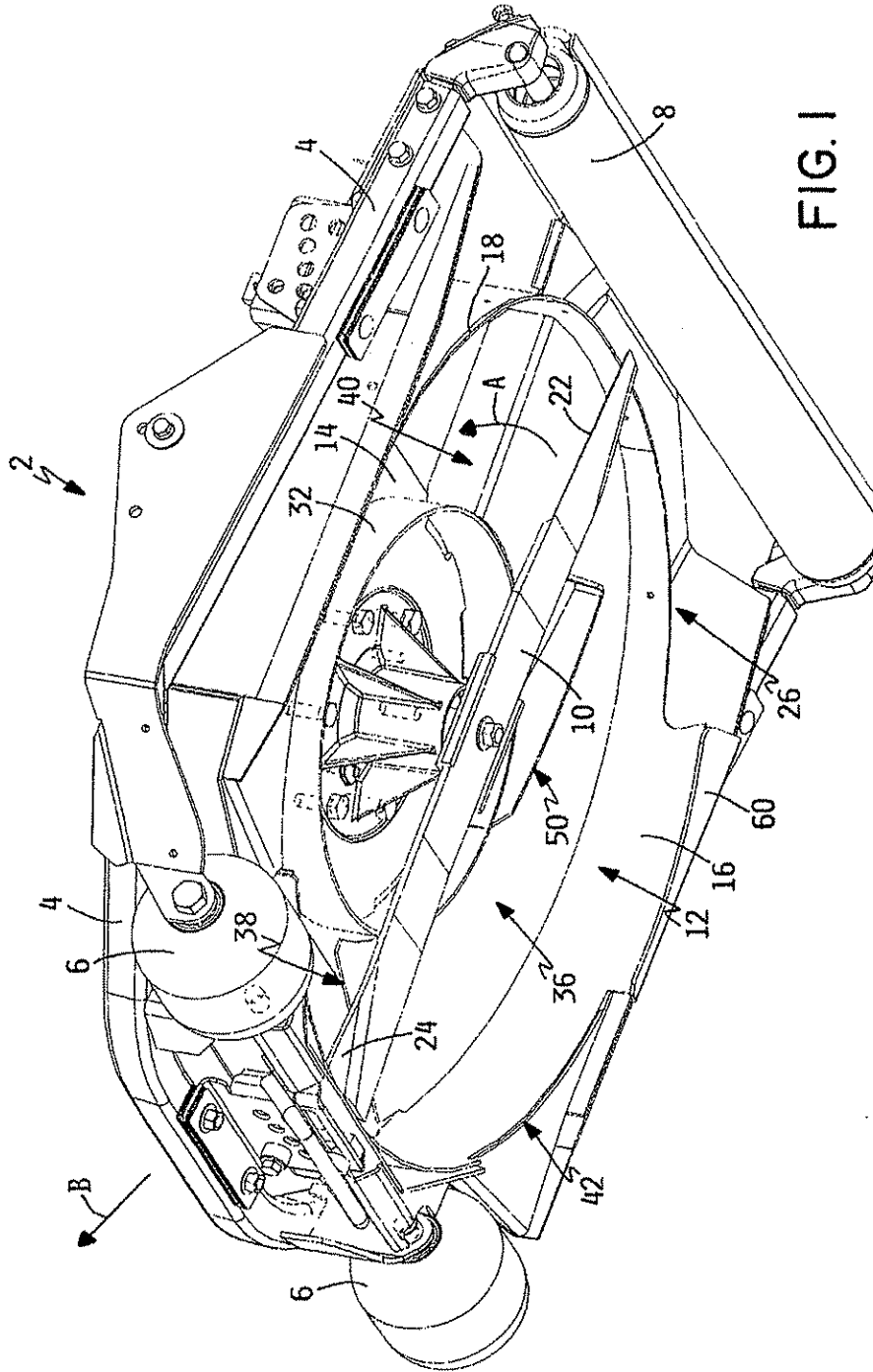


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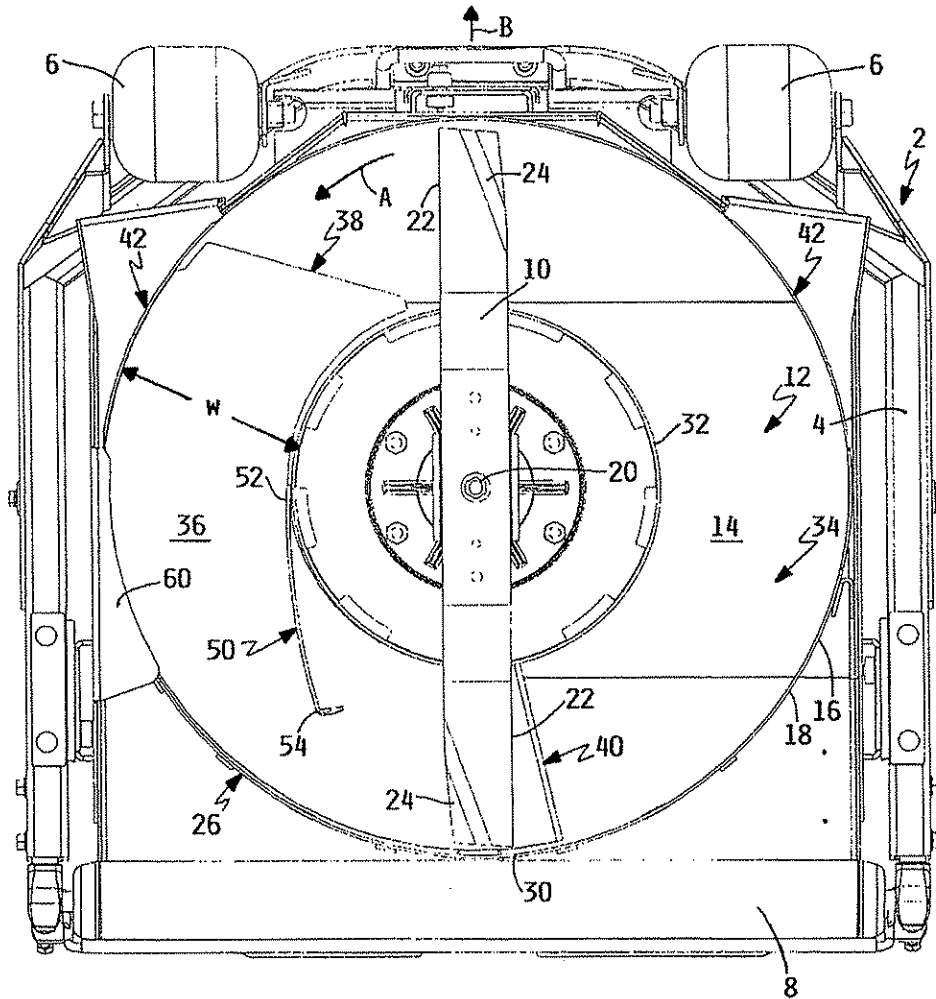


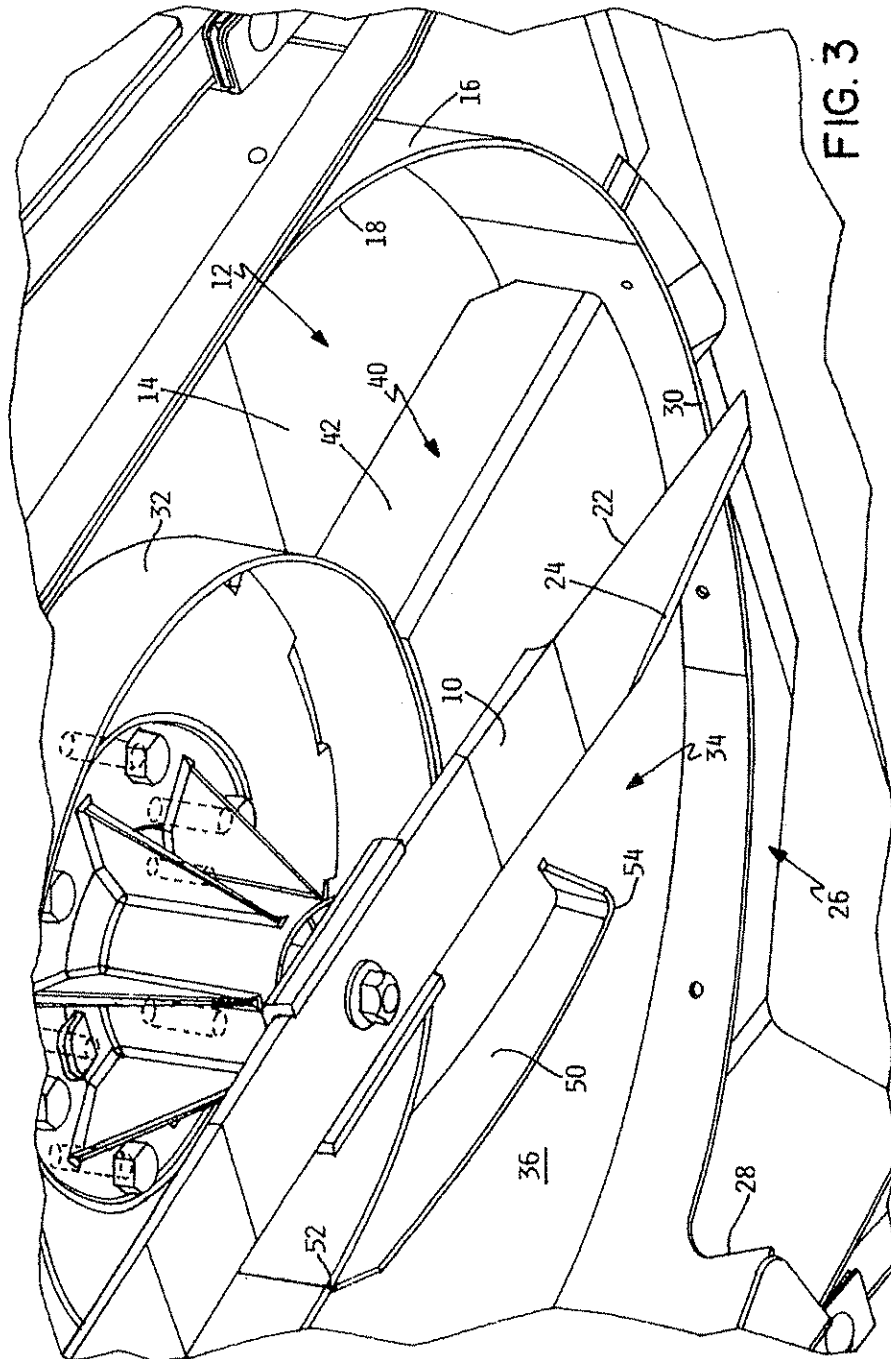
FIG. 2

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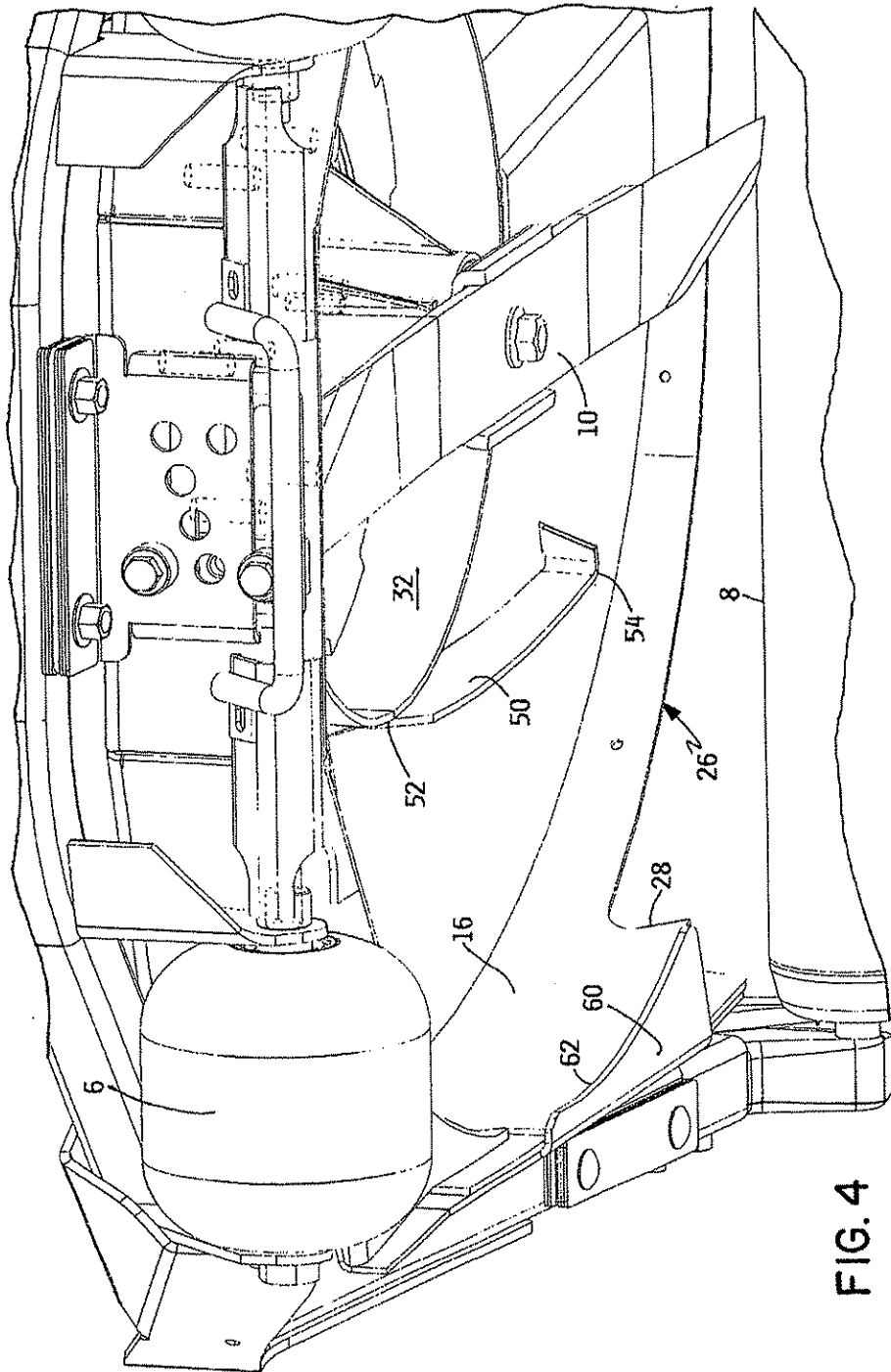


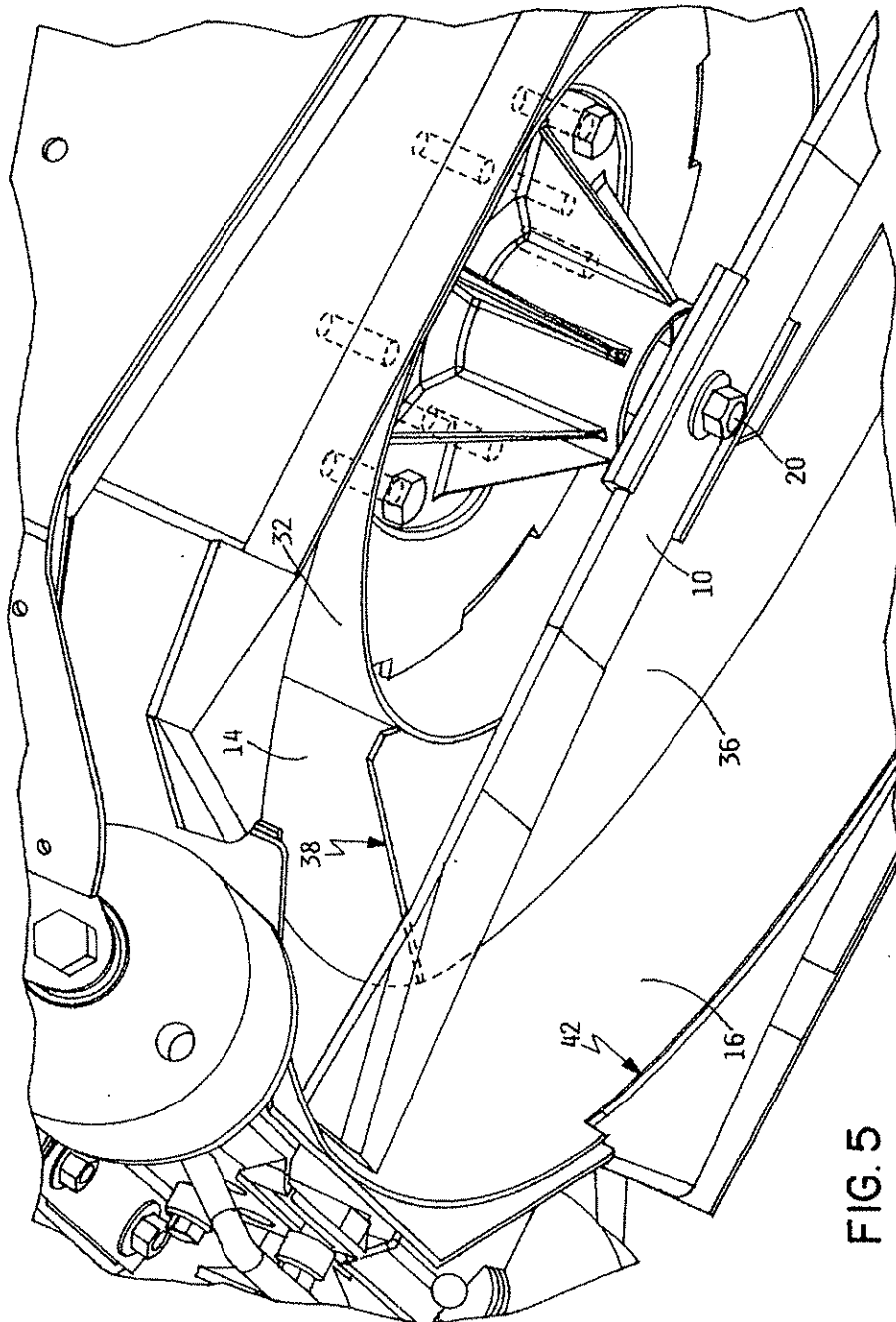
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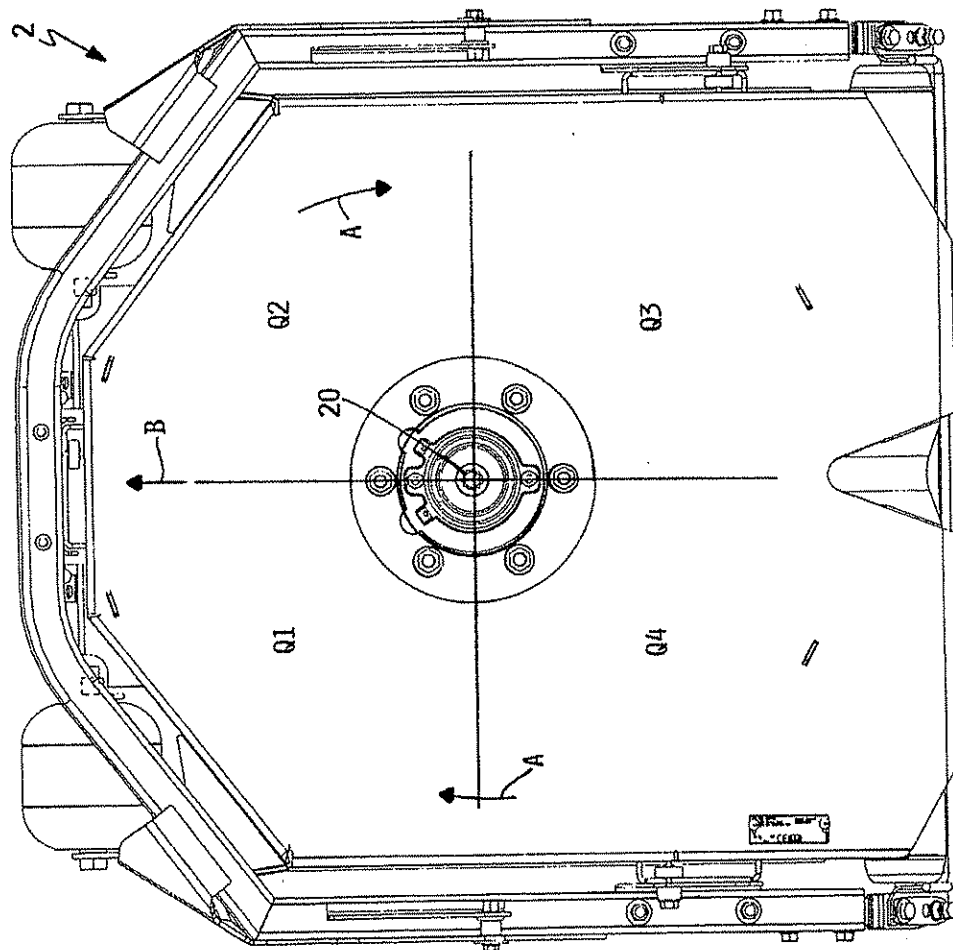


FIG. 6



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## REAR DISCHARGE ROTARY CUTTING DECK FOR MOWER

### TECHNICAL FIELD

This invention relates to a rotary cutting deck, namely to a cutting deck having at least one cutting blade that rotates in a substantially horizontal cutting plane, for use as part of a mower for cutting grass. More particularly, this invention relates to a cutting deck which discharges the grass clippings to the rear of the deck when the deck is configured in a grass discharge mode.

### BACKGROUND OF THE INVENTION

Mowers are known for mowing large areas of grass, such as those in parks, golf courses, athletic fields, and the like. Many such mowers comprise a self-propelled traction frame that is part of a vehicle on which the operator sits as the mower is operated. At least one cutting deck, and often a plurality of cutting decks, are attached to the traction frame to cut a swath of grass as the traction frame moves forwardly. These cutting decks are usually attached to the traction frame by various known suspensions or linkages that permit the cutting decks to float relative to the ground so that the cutting decks follow or adjust to the contours of the ground as they pass over the ground.

Rotary cutting decks are often used as the cutting decks in mowers of this type. Rotary cutting decks are so named not because the decks themselves rotate in circles, but because the decks house one or more rotary cutting blades that rotate in circles in substantially horizontal cutting planes. Single spindled decks are known in which a single cutting blade is contained within each cutting deck. Thus, when a mower is equipped with a plurality of single spindled decks, each individual deck will be ground following and will contain a single rotary cutting blade, the decks being staggered and overlapped with one another so that all the decks collectively cut a single swath of grass.

As grass is cut by a given rotary cutting deck, grass clippings are generated which are eventually deposited onto the ground, assuming they are not first collected in some type of grass bagging attachment. Some rotary cutting decks are designed specifically as mulching decks in which the grass clippings fall or are driven out of the deck in a generally downward direction through an open bottom face of the deck. Some mulching decks of this type carry various baffles or deflectors which extend downwardly from the top wall of the deck into the flow of the grass clippings circulating within the deck to assist or speed in the downward movement of the grass clippings out of the mulching deck. U.S. Pat. No. 5,133,176 to Baumann et al., assigned to The Toro Company, the assignee of this invention, shows a mulching deck of this type.

Dedicated mulching decks, namely decks which only mulch by confining the grass clippings within the cutting deck until they exit through the open bottom of the cutting deck, do not permit the side or rear discharge of the grass clippings. Some operators of equipment of this type prefer mowers which also have the ability to discharge the grass clippings in a generally horizontal path through or beneath the peripheral wall of the cutting deck as opposed to having the clippings be driven vertically downwardly as in a mulching deck. A rotary cutting deck is a side discharge deck where the grass clippings are discharged to one side of the deck while a rear discharge deck is one where the grass clippings are discharged to the rear of or behind the cutting deck. In mowers where a plurality of cutting decks are

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carried on a traction frame, rear discharge decks are typically preferred over side discharge decks.

Some cutting decks are convertible between mulching and grass discharge modes by virtue of removable or openable covers that can be used to block the grass discharge outlets to place the mower into a mulching mode. In the mulching mode, since the grass discharge outlet is blocked, the grass clippings must necessarily fall out through the open bottom of the cutting deck. The operator can easily convert this cutting deck to a grass discharge mode simply by removing or opening the cover blocking the grass discharge outlet provided in the peripheral wall of the cutting deck. When this is done, the natural horizontal circulation of the grass clippings inside the deck will cause the vast majority of the clippings to pass through the grass discharge outlet instead of falling out through the open bottom of the cutting deck. U.S. Pat. No. 4,226,074 to Mullet et al. shows a cutting deck convertible between a mulching mode, a side discharge mode, and a rear discharge mode.

In the mower shown in the Mullet et al. patent, the rear discharge mode is effected simply by opening a cover that normally blocks a rear discharge opening in each individual cutting chamber of the cutting deck. While this is effective in allowing the grass clippings to exit to the rear of the deck, no particular thought or design was given to effecting an even distribution of grass clippings behind the mower. Thus, in many prior art mowers such as that shown in the Mullet et al. patent, the grass clippings deposited to the rear of the cutting deck will often lie on top of the turf in large clumps or groups. This condition will be particularly present and noticeable when the grass being cut has grown fairly long such that the grass clippings themselves are fairly long and/or when the grass being cut is relatively wet.

There is an increasing tendency in the turf care area for the owners of the site being cut to require a highly finished and groomed look after the grass on the site is cut. In other words, once the mowing operation is completed, the presence of visible grass clippings or clumps of grass clippings on top of the turf is increasingly undesirable, even for mowers whose cutting decks are operating in grass discharge modes. Instead, grass clippings being discharged to the side or rear of a cutting deck are desirably spread out as evenly and as smoothly as possible. Rotary cutting decks which are capable of this are more desirable to the purchasers of such equipment.

### SUMMARY OF THE INVENTION

One aspect of this invention relates to a rotary cutting deck for a mower which includes at least one cutting chamber formed by a top wall and a peripheral wall. A rotary cutting blade is carried in the cutting chamber for rotation in the cutting chamber. The cutting blade rotates about a substantially vertical axis in a substantially horizontal cutting plane when the cutting deck and rotary cutting blade are in operation. A grass discharge outlet is provided in the peripheral wall of the cutting chamber for allowing grass clippings to exit from the cutting chamber in a substantially horizontal path. In addition, a ramp is located adjacent at least the peripheral wall of the cutting chamber. The ramp has a progressively increasing depth between a front end and a rear end thereof. The front end of the ramp is ahead of the grass discharge outlet and the rear end of the ramp is located adjacent some portion of the grass discharge outlet.

Another aspect of this invention relates to a rotary cutting deck for a mower which includes at least one cutting chamber formed by a top wall and a peripheral wall. The



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cutting chamber has two front and two rear quadrants taken with respect to forward motion of the cutting chamber. A rotary cutting blade is carried in the cutting chamber for rotation in the cutting chamber, the cutting blade rotating about a substantially vertical axis in a substantially horizontal cutting plane when the cutting deck and rotary cutting blade are in operation. A grass discharge outlet is provided in the peripheral wall of the cutting chamber with the grass discharge outlet being located in at least one rear quadrant of the cutting chamber for allowing grass clippings to exit to the rear of the cutting chamber in a substantially horizontal path. A ramp extends downwardly from the top wall of the cutting chamber and has a progressively increasing depth between a front end and a rear end thereof. The front end of the ramp is located in a front quadrant of the cutting chamber and the rear end of the ramp is located in a rear quadrant of the cutting chamber. The ramp deflects grass clippings downwardly in the cutting chamber towards the grass discharge outlet.

Yet another aspect of this invention relates to a rotary cutting deck for a mower which includes at least one cutting chamber formed by a top wall and a peripheral wall. A rotary cutting blade is carried in the cutting chamber for rotation in the cutting chamber, the cutting blade rotating about a substantially vertical axis in a substantially horizontal cutting plane when the cutting deck and rotary cutting blade are in operation. A grass discharge outlet is provided in the peripheral wall of the cutting chamber for allowing grass clippings to exit to the rear of the cutting chamber in a substantially horizontal path. A generally vertical vane extends downwardly within the cutting chamber and is angled so as to be non-concentric to the peripheral wall. The vane begins in advance of the grass discharge outlet and ends behind an entrance of the grass discharge outlet taken with respect to the direction of blade rotation.

#### BRIEF DESCRIPTION OF THE DRAWINGS

This invention will be described hereafter in the Detailed Description, taken in conjunction with the following drawings, in which like reference numerals refer to like elements or parts throughout.

FIG. 1 is a perspective view of a rotary cutting deck according to this invention, particularly illustrating the underside of the cutting deck;

FIG. 2 is a bottom plan view of the rotary cutting deck of FIG. 1;

FIG. 3 is an enlarged perspective view of a portion of the rotary cutting deck shown in FIG. 1, particularly illustrating the rear discharge outlet, the rear end of the ramp used to deflect the grass clippings towards the rear discharge outlet and the downwardly extending grass clipping divider vane placed on the ramp;

FIG. 4 is an enlarged perspective view of a portion of the rotary cutting deck shown in FIG. 1, particularly illustrating the baffle placed on the lower edge of the peripheral wall of the cutting chamber in advance of the rear discharge outlet for helping minimize dribbling or streaking of grass clippings along the side of the cutting deck;

FIG. 5 is an enlarged perspective view of a portion of the rotary cutting deck shown in FIG. 1, particularly illustrating the front end of the ramp used to deflect the grass clippings towards the rear discharge outlet; and

FIG. 6 is a top plan view of the cutting deck showing the four quadrants comprising the cutting chamber and the quadrant designations assigned to these quadrants herein with the cutting deck being upright and looking down on the

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cutting deck from above, the arrow A in FIG. 6 indicating the direction of blade rotation and the arrow B in FIG. 6 indicating the direction of forward motion of the cutting deck.

#### DETAILED DESCRIPTION

One embodiment of a rotary cutting deck according to this invention is shown in FIGS. 1-5 with the rotary cutting deck being generally illustrated as 2. Cutting deck 2 is of the type that is intended to be attached to a traction frame (not shown) of a mower (not shown) so that cutting deck 2 is propelled over the ground as the mower travels over the ground. One cutting deck 2 or multiple cutting decks 4 may be attached to the mower. Preferably, each cutting deck 2 is attached to the mower in ways that permit each cutting deck 2 to individually follow the contours of the ground when cutting decks 2 are being used to cut grass. The types of suspensions and linkages (not shown) that are used to accomplish such ground following action, and the types of mowers on which cutting decks 2 of this type may be used, are well known in the turf care industry and need not be further described herein.

Cutting deck 2 of this invention has a superstructure or frame 4 on which various elements of cutting deck 2 are carried. For example, frame 4 mounts two laterally spaced apart front rollers 6 and a rear roller 8 which engage the ground during when cutting deck 2 is being used to cut grass. These rollers 6 and 8 allow cutting deck 2 to roll over the surface of the ground with the forward propulsive force for cutting deck 2 coming from the traction frame of the mower through the suspensions and linkages that attach cutting deck 2 to the mower. In addition, cutting deck 2 would typically carry some type of drive motor (not shown), e.g. a hydraulic or electric drive motor, on the top of cutting deck 2, which drive motor is not visible in the figures since cutting deck 2 is tipped up in the figures to show the underside of cutting deck 2. This drive motor is used to rotate a rotary cutting blade 10 that is carried in a cutting chamber 12 that is part of cutting deck 2.

The exact nature of the superstructure or frame 4 of cutting deck 2, or of the types of ground engaging members that support cutting deck 2 for rolling over the ground, or how cutting blade 10 is rotated, are not important to this invention. This invention relates primarily to the structure of cutting chamber 12 and particularly to various elements thereof which promote the even and uniform discharge of grass clippings through a grass discharge outlet. Thus, this invention could be used on cutting decks 2 having various types of superstructures or frames 4, or on cutting decks 2 which might have ground engaging members other than rollers 6 and 8, such as skids, or on cutting decks 2 having no ground engaging members where each cutting deck 2 is simply suspended in some fashion from the traction frame of the mower, or on cutting decks 2 where rotary cutting blades 10 are powered by other than drive motors carried on cutting decks 2, such as by a belt drive taken from a PTO on the mower. Accordingly, the remaining description will focus on those elements of cutting deck 2 to which the present invention is directed in some way.

Cutting deck 2 of this invention carries a cutting chamber 12 that is formed by a top wall 14 of cutting deck 2 and by a generally circular peripheral wall 16 that extends downwardly from top wall 14. Peripheral wall 16 terminates in a lower edge 18 that faces the ground when cutting deck 2 is upright and is being used to cut grass. A steel cutting blade 10 is carried on a drive spindle 20, i.e. on either the drive

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shaft of the aforementioned drive motor or on a drive spindle of a belt drive or the like. Steel cutting blade 10 thus rotates about a substantially vertical axis, i.e. the axis of drive spindle 20, such that cutting blade 10 rotates in a substantially horizontal cutting plane within cutting chamber 12.

As is typical of most rotary blades 10, the leading edges of the radial outer ends of cutting blade 10 have sharpened cutting edges 22. The trailing edges of the radial outer ends of cutting blade 10 have upturned sails 24 that follow cutting edges 22 of cutting blade 10. As cutting blade 10 rotates in the direction indicated by the arrows  $\Lambda$  in FIGS. 1 and 2, cutting edges 22 of cutting blade 10 cut the grass and sails 24 generate an airflow in cutting chamber 12 which airflow circulates in the same direction as the direction of rotation of cutting blade 10. The grass clippings which have been created by the cutting action of cutting edges 22 of cutting blade 10 are entrained in this airflow and circulate within cutting chamber 12 until such time as they exit cutting chamber 12.

In cutting deck 2 of this invention, cutting chamber 12 is designed to have a grass discharge mode in which the grass clippings are allowed to exit in a generally horizontal path or direction from cutting chamber 12 so as to be thrown out on top of the ground or turf. More particularly, cutting chamber 12 is designed to discharge the grass clippings to the rear of cutting chamber 12, though they could also be discharged from cutting chamber 12 in some other direction. In addition, cutting chamber 12 is designed to discharge the grass clippings to the rear of cutting chamber 12 in a more uniform and even fashion than other prior art rotary cutting decks.

In achieving these objectives, cutting deck 2 of this invention includes a rear discharge outlet 26 in cutting chamber 12 to allow the grass clippings to exit to the rear of cutting chamber 12. For reference purposes, cutting chamber 12 can be thought of as having four quadrants, labelled Q1, Q2, Q3 and Q4 in the view of FIG. 6, with quadrant 1 being the left front quadrant, quadrant 2 being the right front quadrant, quadrant 3 being the right rear quadrant, and quadrant 4 being the left rear quadrant. In these quadrant designations, it is assumed that cutting deck 2 is upright and the reference to right and left is made while looking down on cutting deck 2 from above. The reference to front and rear is made with respect to the direction of forward motion of the cutting deck 2 when the mower is moving forwardly as shown by the arrows B in FIGS. 1, 2 and 6. With this reference system in mind and with the direction of rotation of cutting blade 10 as shown by the arrows A in FIGS. 1, 2 and 6, most of the actual cutting of grass by cutting blade 10 takes place in quadrants 1 and 2.

Rear discharge outlet 26 in cutting chamber 12 is located primarily in quadrants 3 and 4, i.e. in the two rear quadrants of cutting chamber 12. Rear discharge outlet 26 is formed by a cut-away portion of peripheral wall 16 of cutting chamber 12. The entrance 28 of rear discharge outlet 26 is formed by a sharp cornered, vertical surface which begins the cut-away portion of peripheral wall 16. The cutaway portion of peripheral wall 16 then extends around quadrant 3 from sharp cornered entrance 28 to a transition point 30 that is located approximately at the end of quadrant 3 or slightly past the end of quadrant 3 and somewhat into quadrant 4. See FIG. 3. Unlike sharp cornered entrance 28, transition point 30 of rear discharge outlet 26 is simply a point at which peripheral wall 16 begins to gradually lengthen again until it regains its normal full height at some point about in the middle of quadrant 4.

Thus, considering rear discharge outlet 26 from its beginning to its end travelling in the direction of rotation of blade

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10, one encounters sharp cornered entrance 28, a first section of rear discharge outlet 26 having a substantially constant depth for the cut-away portion with this first section ending at transition point 30, and a second section of rear discharge outlet 26 in which the depth of the cut-away portion progressively lessens until the cutaway portion simply fades away. The placement of the end of rear discharge outlet 26 can vary but is preferably somewhat symmetrically arranged in quadrant 4 to the placement of entrance 28 in quadrant 3. In other words, rear discharge outlet 26 extends across approximately the rear half of quadrant 3 and the front half of quadrant 4 to lie generally adjacent rear roller 8.

The grass clippings tend to circulate naturally within cutting chamber 12 in a path that is adjacent peripheral wall 16 due to centrifugal force. To accentuate this tendency, cutting chamber 12 is provided with an inner, concentric shroud 32 that serves to form an annular or doughnut shaped grass discharge channel 34 between itself and peripheral wall 16. Grass discharge channel 34 has a radial width indicated as w in FIG. 2. The use of inner concentric shroud 32, while not mandatory, is preferred as it cuts down on any inward drift of grass clippings across cutting chamber 12 and reinforces the tendency of the grass clippings to circulate in a confined, annular path by providing an annular grass discharge channel 34 in which the grass clippings naturally move.

A grass deflecting ramp 36 is located in grass discharge channel 34 between inner concentric shroud 34 and peripheral wall 16. Ramp 36 has a front end 38 that is located approximately midway in quadrant 2 of cutting chamber 12 in advance of sharp cornered entrance 28 of rear discharge outlet 26. Front end 38 of ramp 36 lies closely against the underside of top wall 14 with only the thickness of the plate material which forms ramp 36 extending beneath top wall 14. See FIGS. 1 and 5. From front end 38 of ramp 36, ramp 36 progressively lowers within cutting chamber 12, i.e. moves away from top wall 14 of cutting chamber 12 and towards lower edge 18 of peripheral wall 16 of cutting chamber 12, until ramp 36 terminates at a rear end 40.

Referring now to FIGS. 1 and 3, rear end 40 of ramp 36 has dropped slightly more than halfway down the normal full height of peripheral wall 16 of cutting chamber 12 with rear end 40 being still slightly above the cut-away portion forming rear discharge outlet 26. In addition, rear end 40 of ramp 36 is located again approximately at the end of quadrant 2 or slightly into quadrant 3. As shown in FIG. 3, rear end 40 of ramp 36 is a few inches past transition point 30 of rear discharge outlet 26 where the cut-away portion begins to taper upwardly. Also as shown in FIG. 3, rear end 40 of ramp 36 includes a vertical surface 42 that extends back upwardly to top wall 14 of cutting chamber 12 so that rear end 40 of ramp 36 is not open, but is closed. Thus, grass clippings cannot collect beneath rear end 40 of ramp 36. In addition, ramp 36 desirably extends across the entire width w of grass discharge channel 34 to abut against both inner concentric shroud 32 and peripheral wall 16 to prevent grass clippings from wedging or packing between the sides of ramp 36 and shroud 32 or peripheral wall 16. See FIG. 2.

Grass discharge outlet 26 is sufficiently deep that the tips or radial outer ends of cutting blade 10 become exposed over most of the length of grass discharge outlet 26. The tips of blade 10 similarly are exposed in front cut-outs 44 on each side of cutting deck 2. However, front cut-outs 44 form no part of this invention, but are the subject, inter alia, of a copending U.S. patent application, namely Ser. No. 09/489, 180.

The Applicants have found that the combination of a rear discharge outlet 26 with a grass deflecting ramp 36 allows

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for an efficient and smooth discharge of grass clippings from cutting chamber 12. The use of a ramp 36 is better than simply allowing grass clippings to flow through an open rear outlet as ramp 36 directs the grass clippings more smoothly to and through rear discharge outlet 26. This would, of course, also be true with a side discharge outlet instead of a rear discharge outlet 26. A ramp 36 whose front end 38 is in advance of the entrance to the discharge outlet and whose rear end 40 is located somewhere approximately at least in the middle of the discharge outlet seems to promote a better and more even flow of grass clippings through the discharge outlet, whether that discharge outlet points to the rear of cutting deck 2 or in some other direction.

In some grass conditions, the Applicants have noticed that the discharge of grass clippings was heavier in the middle of the grass clipping discharge swath. To prevent this and to better even out the side-to-side distribution of grass clippings across the width of the grass clipping discharge swath, the Applicants placed a downwardly extending, grass clippings guide or divider vane 50 on ramp 36.

Referring now to FIG. 2, vane 50 is located between inner concentric shroud 32 and peripheral wall 16 of cutting chamber 12. Vane 50 begins, as shown at 52, approximately at the beginning of quadrant 3 somewhat in advance of entrance 28 to rear discharge outlet 26 and somewhat behind front end 38 of ramp 36. Vane 50 ends, as shown at 54, in the middle of quadrant 3 behind entrance 28 to rear discharge outlet 26 but in front of rear end 40 of ramp 36. Vane 50 is not concentric to inner concentric shroud 32 or peripheral wall 16, but angles across ramp 36 from inner concentric shroud 32 towards peripheral wall 16. The end of vane 50 does not extend all the way to peripheral wall 16 or to rear discharge outlet 26 therein, but terminates about halfway across the width of ramp 36.

The Applicants found that with the use of vane 50, the tendency of the grass clippings to be deposited more heavily in the middle of the clipping discharge swath was minimized. In other words, the grass clippings were more evenly distributed from side to side in the swath in which they are deposited behind cutting deck 2. Precisely why this is true is somewhat uncertain, though Applicants believe that vane 50 forms a barrier that forces some clippings to be discharged closer to entrance 28 of rear discharge outlet 26 than would otherwise be true.

While use of vane 50 is preferred in promoting a more even side-to-side distribution of grass clippings, ramp 36 and rear discharge outlet 26 could obviously be used, and would have benefits over the prior art, without also using vane 50 thereon. In addition, a vane 50 used in an annular grass discharge channel 34 in a cutting chamber 12 with vane 50 beginning in advance of a grass discharge outlet and pointing towards outlet 26 would have benefits in promoting a more even side-to-side distribution even if it were not used on the underside of a grass deflecting ramp 36. Accordingly, ramp 36 and vane 50 could be used separately from one another, though desirably they are used together.

Finally, in certain grass conditions, the Applicants also noticed a tendency for grass clippings to dribble out or be deposited in a streak along the side of cutting chamber 12. To prevent or minimize this from occurring, the Applicants added a horizontal baffle 60 on lower edge 18 of peripheral wall 16 of cutting chamber 12 in advance of entrance 28 to rear discharge outlet 26 but again behind front end 38 of ramp 36. Referring to FIG. 2, baffle 60 extends across the junction between quadrants 2 and 3 with a portion of baffle 60 lying at the very rear of quadrant 2 and a somewhat larger

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portion of baffle 60 lying at the front of quadrant 3. As shown in FIG. 4, baffle 60 has a radially innermost lip 62 that extends slightly over lower edge 18 of peripheral wall 16 to protrude somewhat radially inwardly into annular grass discharge channel 34.

The Applicants found that such a baffle 60 with its radially inwardly protruding lip 62 minimized any grass dribbling or streaking along the side of cutting chamber 12. Again, while use of baffle 60 is preferred for this reason, it is not strictly necessary to the use of the other elements of this invention. Baffle 60 could be deleted if so desired.

Various modifications of this invention will be apparent to this skilled in the art. The description of one embodiment of a rotary cutting deck 2 according to this invention is not meant to state or imply that this is the only cutting deck 2 that could be made embodying this invention. For example, the length and placement of ramp 36 could vary as well as the depth of ramp 36 at its rear end 40. The length, shape and placement of discharge outlet 26 could vary. The length and orientation of vane 50 could vary. The amount of overlap of baffle 60 on lower edge 18 of peripheral wall 16 could vary. Vane 50 and baffle 60 need not necessarily be used with each other or with ramp 36.

In addition, cutting deck 2 could be made such that rear discharge outlet 26 is always open or, alternatively, rear discharge outlet 26 could be selectively closed by some type of cover to convert cutting deck 2 from a grass discharge to a mulching mode. This invention relates to either type of cutting deck 2, i.e. one which is solely a grass discharge deck or one which is convertible between grass discharge and mulching modes. Thus, the scope of this invention is to be limited only by the appended claims.

We claim:

1. A rotary cutting deck for a mower, which comprises:

- (a) at least one cutting chamber formed by a top wall and a peripheral wall having a lower edge;
- (b) a rotary cutting blade carried in the cutting chamber for rotation in the cutting chamber, the cutting blade rotating about a substantially vertical axis in a substantially horizontal cutting plane when the cutting deck and rotary cutting blade are in operation;
- (c) a grass discharge outlet in the peripheral wall of the cutting chamber adjacent the lower edge of the peripheral wall for allowing grass clippings to exit from the cutting chamber in a substantially horizontal path; and
- (d) a ramp located adjacent at least the peripheral wall of the cutting chamber, wherein the ramp has a progressively increasing depth between a front end and a rear end thereof such that the ramp progressively moves away from the top wall and towards the lower edge of the peripheral wall as the ramp extends between the front and rear ends thereof such that grass clippings travelling within the cutting chamber and engaging the front end of the ramp will be progressively forced downwardly by the ramp away from the top wall towards the grass discharge outlet adjacent the lower edge of the peripheral wall, wherein the front end of the ramp is ahead of the grass discharge outlet and rear end of the ramp is located adjacent some portion of the grass discharge outlet.

2. The rotary cutting deck of claim 1, wherein the cutting chamber further includes an inner shroud that is located concentrically inside of the peripheral wall to form an annular grass discharge channel between the inner shroud and the peripheral wall, and wherein the ramp is located in the annular grass discharge channel.



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3. The rotary cutting deck of claim 2, wherein the grass discharge channel has a width measured by the distance between the inner shroud and peripheral wall along a radial line extending outwardly from a center of the cutting chamber, and wherein the ramp spans across substantially the entire width of the grass discharge channel.

4. The rotary cutting deck of claim 1, wherein the cutting chamber has quadrants 1-4 with quadrants 1 and 2 being front quadrants and quadrants 3 and 4 being rear quadrants taken with respect to forward movement of the cutting chamber, the cutting blade rotating progressively through quadrants 1-4 during one complete cycle of rotation, and wherein the discharge outlet has an entrance located within the quadrant 3 and an exit located in quadrant 4 such that grass clippings are discharged through the discharge outlet towards the rear of the cutting deck.

5. The rotary cutting deck of claim 4, wherein the front end of the ramp is located in quadrant 2.

6. The rotary cutting deck of claim 5, wherein the rear end of the ramp is located approximately at the end of quadrant 3 or in the beginning of quadrant 4.

7. The rotary cutting deck of claim 6, wherein the depth of the ramp at the rear end of the ramp is approximately half the cutting chamber's depth.

8. The rotary cutting deck of claim 6, wherein the depth of the ramp at the rear end of the ramp is such that the rear end of the ramp is located slightly above the grass discharge outlet.

9. The rotary cutting deck of claim 1, wherein the grass discharge outlet is along a rear side of the cutting deck.

10. The rotary cutting deck of claim 9, wherein the grass discharge outlet is a cut-away portion of the peripheral wall.

11. The rotary cutting deck of claim 10, wherein the cut-away portion of the peripheral wall forming the grass discharge outlet has a sharp cornered entrance leading to a first section of generally constant depth and a second section of progressively decreasing depth such that the cut-away portion gradually fades away over the second section thereof until the peripheral wall is restored to its full height.

12. The rotary cutting deck of claim 1, further including at least one generally vertical vane extending downwardly from the ramp.

13. The rotary cutting deck of claim 12, wherein the vane begins behind the front end of the ramp and ends in advance of the rear end of the ramp.

14. The rotary cutting deck of claim 13, wherein the vane ends at a rear end that points towards an intermediate portion of the grass discharge outlet but is spaced from the grass discharge outlet.

15. The rotary cutting deck of claim 14, wherein the cutting chamber further includes an inner shroud that is located concentrically inside of the peripheral wall to form an annular grass discharge channel between the inner shroud and the peripheral wall, and wherein the ramp is located in the annular grass discharge channel.

16. The rotary cutting deck of claim 15, wherein the vane begins at the inner shroud slightly in advance of the grass discharge outlet and angles across the grass discharge channel so as to be non-concentric with the inner shroud and the peripheral wall.

17. The rotary cutting deck of claim 12, further including a baffle located on a lower edge of the peripheral wall substantially immediately in advance of the grass discharge outlet, wherein the baffle has a radially inner lip that protrudes radially inwardly over the lower edge of the peripheral wall.

18. The rotary cutting deck of claim 1, further including a baffle located on a lower edge of the peripheral wall

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substantially immediately in advance of the grass discharge outlet, wherein the baffle has a radially inner lip that protrudes radially inwardly over the lower edge of the peripheral wall.

19. A rotary cutting deck for a mower, which comprises:

(a) at least one cutting chamber formed by a top wall and a peripheral wall, the cutting chamber having two front and two rear quadrants taken with respect to forward motion of the cutting chamber;

(b) a rotary cutting blade carried in the cutting chamber for rotation in the cutting chamber, the cutting blade rotating about a substantially vertical axis in a substantially horizontal cutting plane when the cutting deck and rotary cutting blade are in operation;

(c) a grass discharge outlet in the peripheral wall of the cutting chamber with the grass discharge outlet being located in at least one rear quadrant of the cutting chamber for allowing grass clippings to exit to the rear of the cutting chamber in a substantially horizontal path;

(d) a ramp extending downwardly from the top wall of the cutting chamber and having a progressively increasing depth between a front end and a rear end thereof, wherein the front end of the ramp is located in a front quadrant of the cutting chamber and the rear end of the ramp is located in a rear quadrant of the cutting chamber, the ramp deflecting grass clippings downwardly in the cutting chamber towards the grass discharge outlet.

20. A rotary cutting deck for a mower, which comprises:

(a) at least one cutting chamber formed by a top wall and a peripheral wall;

(b) a rotary cutting blade carried in the cutting chamber for rotation in the cutting chamber, the cutting blade rotating about a substantially vertical axis in a substantially horizontal cutting plane when the cutting deck and rotary cutting blade are in operation;

(c) a grass discharge outlet in the peripheral wall of the cutting chamber for allowing grass clippings to exit to the rear of the cutting chamber in a substantially horizontal path; and

(d) a generally vertical divider vane extending downwardly within the cutting chamber and angled so as to be non-concentric to the peripheral wall, the divider vane beginning in advance of the grass discharge outlet and ending behind an entrance of the grass discharge outlet taken with respect to the direction of blade rotation.

21. A rotary cutting deck for a mower, which comprises:

(a) at least one cutting chamber, the cutting chamber including an outer circular peripheral wall forming an outer boundary of the cutting chamber;

(b) an inner concentric shroud located radially inside the peripheral wall to form an annular grass discharge channel between the inner concentric shroud and the peripheral wall;

(c) a rotary cutting blade carried in the cutting chamber for rotation in the cutting chamber, the cutting blade rotating about a substantially vertical axis in a substantially horizontal cutting plane when the cutting deck and rotary cutting blade are in operation, the cutting blade having sharpened cutting edges for severing grass

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and airflow generating sails for causing grass clippings to circulate within the annular grass discharge channel, both the sharpened cutting edges and sails of the cutting blade overlying the grass discharge channel;

- (d) a rear grass discharge outlet formed by a cut-away<sup>5</sup> portion of the lower edge of the peripheral wall of the cutting chamber, the rear grass discharge outlet being located in at least one rear quadrant of the cutting chamber, the rear grass discharge outlet opening into the annular grass discharge channel to permit grass<sup>10</sup> clippings to exit from the grass discharge channel through the rear grass discharge outlet in a generally horizontal path; and

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- (e) a grass deflecting ramp located within the annular grass discharge channel with a front end of the ramp located in advance of an entrance to the rear grass discharge outlet and a rear end of the ramp located in one of the rear quadrants of the cutting chamber to be adjacent some portion of the rear grass discharge outlet, the grass deflecting ramp progressively lowering between its front and rear ends to deflect grass clippings generally downwardly towards the rear discharge outlet, the ramp having a width that spans substantially all the way across the grass discharge channel between the inner concentric shroud and the peripheral wall.

\* \* \* \* \*

UNITED STATES PATENT AND TRADEMARK OFFICE  
**CERTIFICATE OF CORRECTION**

PATENT NO. : 6,470,663 B2  
DATED : October 29, 2002  
INVENTOR(S) : Thomas F. Langworthy et al.

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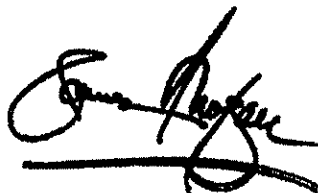
It is certified that error appears in the above-identified patent and that said Letters Patent is hereby corrected as shown below:

Column 8,

Line 59, before "rear end" insert -- the --

Signed and Sealed this

Fourth Day of March, 2003

A handwritten signature in black ink, appearing to read "James E. Rogan", with a horizontal line drawn underneath it.

JAMES E. ROGAN  
*Director of the United States Patent and Trademark Office*

UNITED STATES PATENT AND TRADEMARK OFFICE  
**CERTIFICATE OF CORRECTION**

PATENT NO. : 6,470,663 B2  
DATED : October 29, 2002  
INVENTOR(S) : Thomas F. Langworthy et al.

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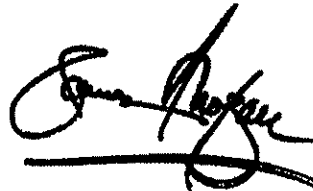
It is certified that error appears in the above-identified patent and that said Letters Patent is hereby corrected as shown below:

Title page.

Item [75], Inventors, add -- **Benjamin A. Street**, Northfield, MN (US) --

Signed and Sealed this

Sixth Day of May, 2003

A handwritten signature in black ink, appearing to read "James E. Rogan", with a horizontal line drawn underneath it.

JAMES E. ROGAN  
*Director of the United States Patent and Trademark Office*

## **EXHIBIT 69**





US006484481B1

(12) **United States Patent**  
**Langworthy et al.**

(10) **Patent No.:** **US 6,484,481 B1**  
(45) **Date of Patent:** **Nov. 26, 2002**

(54) **ROTARY CUTTING UNIT WITH OVATE ROLLERS AND FRONT CORNER CUT-OUTS**

(75) Inventors: **Thomas F. Langworthy**, Belle Plaine, MN (US); **Daniel M. Treu**, Eagan, MN (US)

(73) Assignee: **The Toro Company**, Minneapolis, MN (US)

(\*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **09/489,180**

(22) Filed: **Jan. 21, 2000**

#### Related U.S. Application Data

(60) Provisional application No. 60/011,450, filed on Feb. 9, 1996.

(51) Int. Cl.<sup>7</sup> ..... **A01D 75/30**

(52) U.S. Cl. .... **56/6; 56/15.5**

(58) Field of Search ..... **56/6, 12.7, 255, 56/295, 17.4, 320.1, 320.2, 7, 249, 294, 252, 253, 15.2, 15.5, 14.9, 15.7; D15/17**

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Primary Examiner—Robert E. Pezzuto

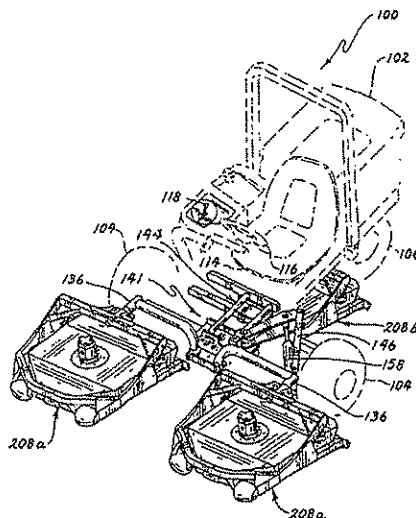
Assistant Examiner—Árpád Fábíán Kovács

(74) Attorney, Agent, or Firm—James W. Miller

(57) **ABSTRACT**

A mower includes a plurality of cutting units carried on a traction vehicle in a staggered and overlapped orientation to provide a cutting swath. The cutting units are rotary type cutting units having cut-outs at each front corner thereof to eliminate or reduce streaking between adjacent cutting units. In addition, each cutting unit has two spaced, ovately shaped ground engaging rollers adjacent each front corner. The ovately shaped rollers are positioned so that a tapered outer end of each roller points to the outside of the cutting unit with the broader, basal end of the roller being positioned closer to the longitudinal centerline of the cutting unit. Such rollers support the front of the cutting unit and allow the front of the cutting unit to roll over the ground.

**13 Claims, 9 Drawing Sheets**

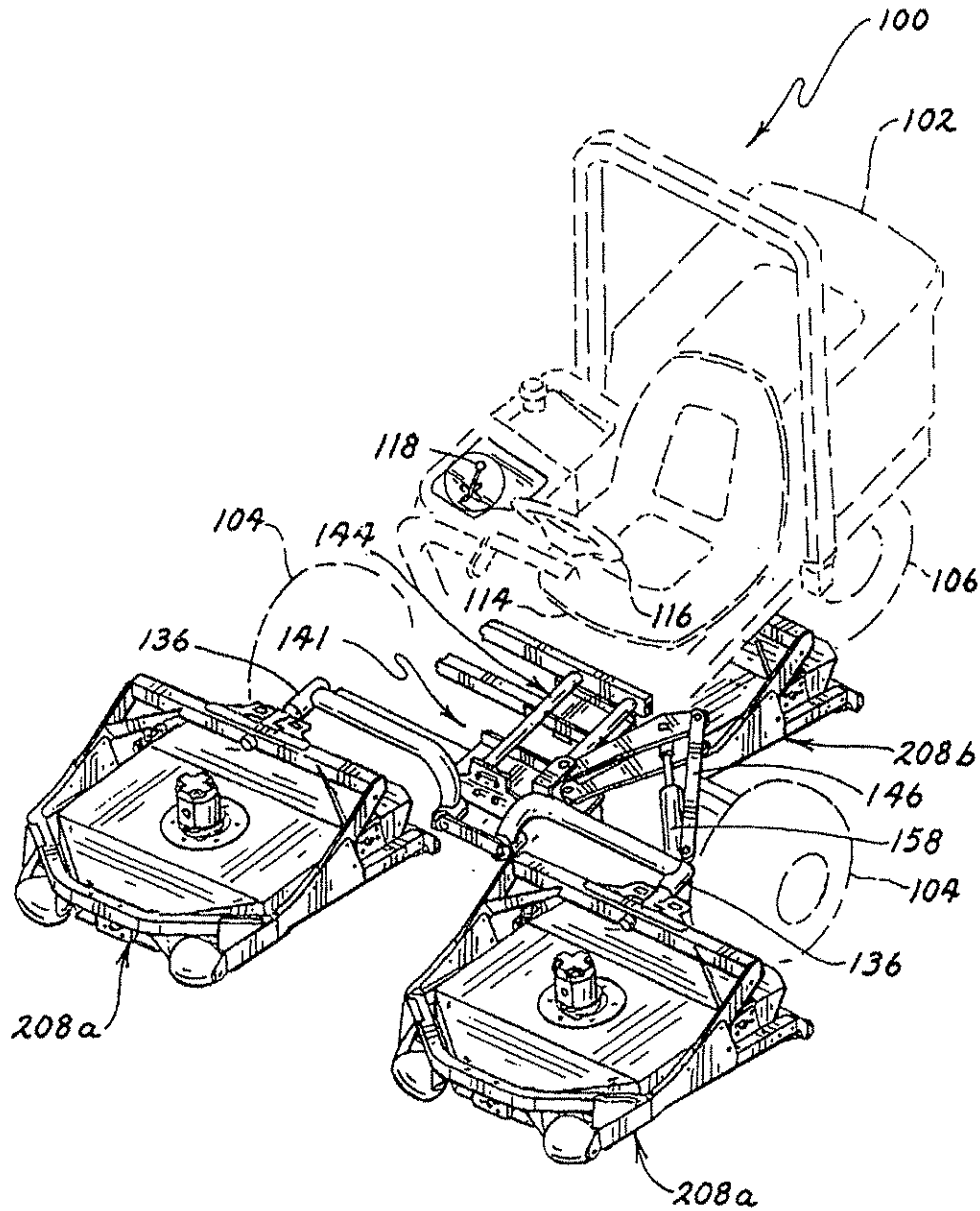


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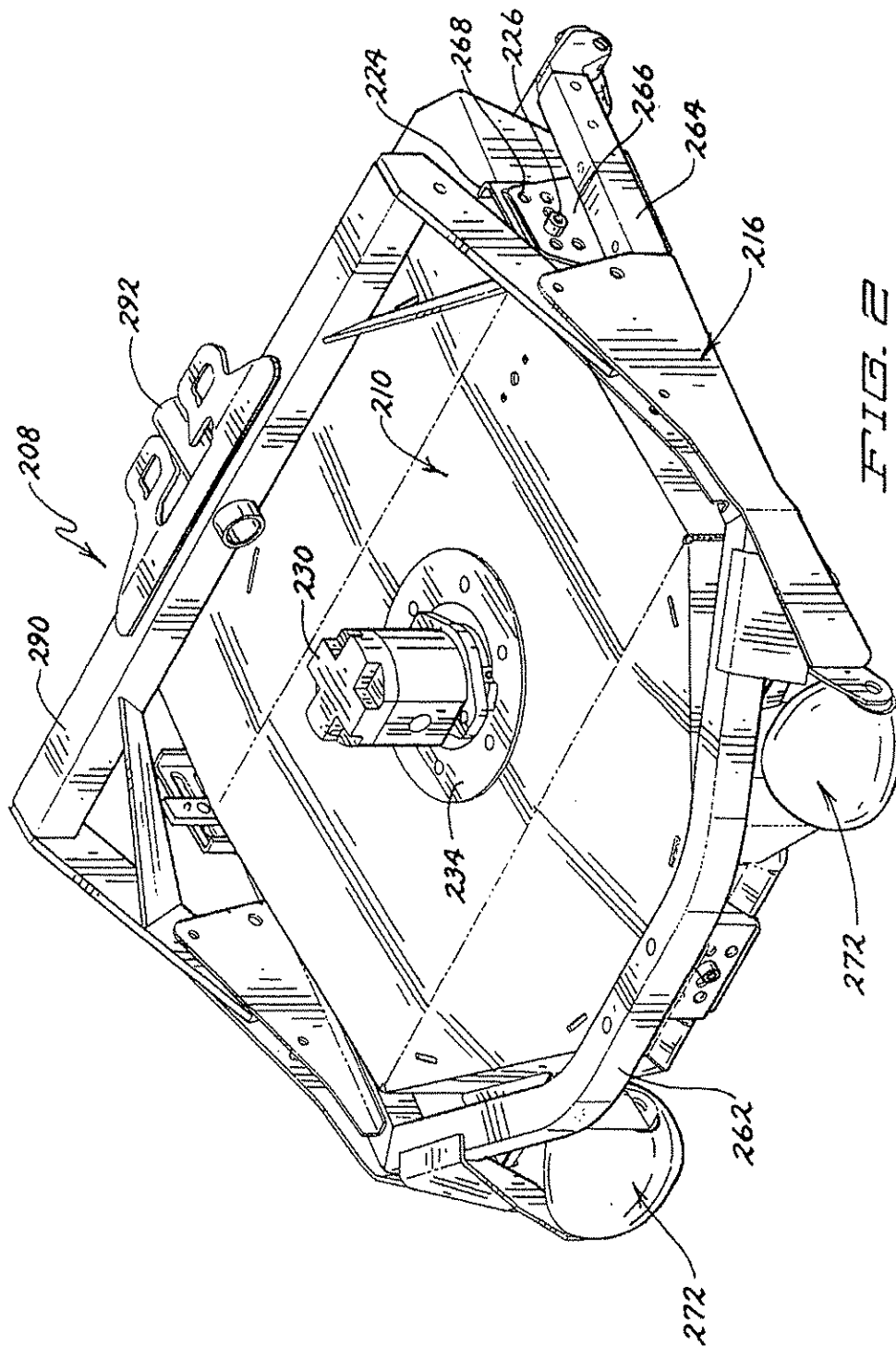


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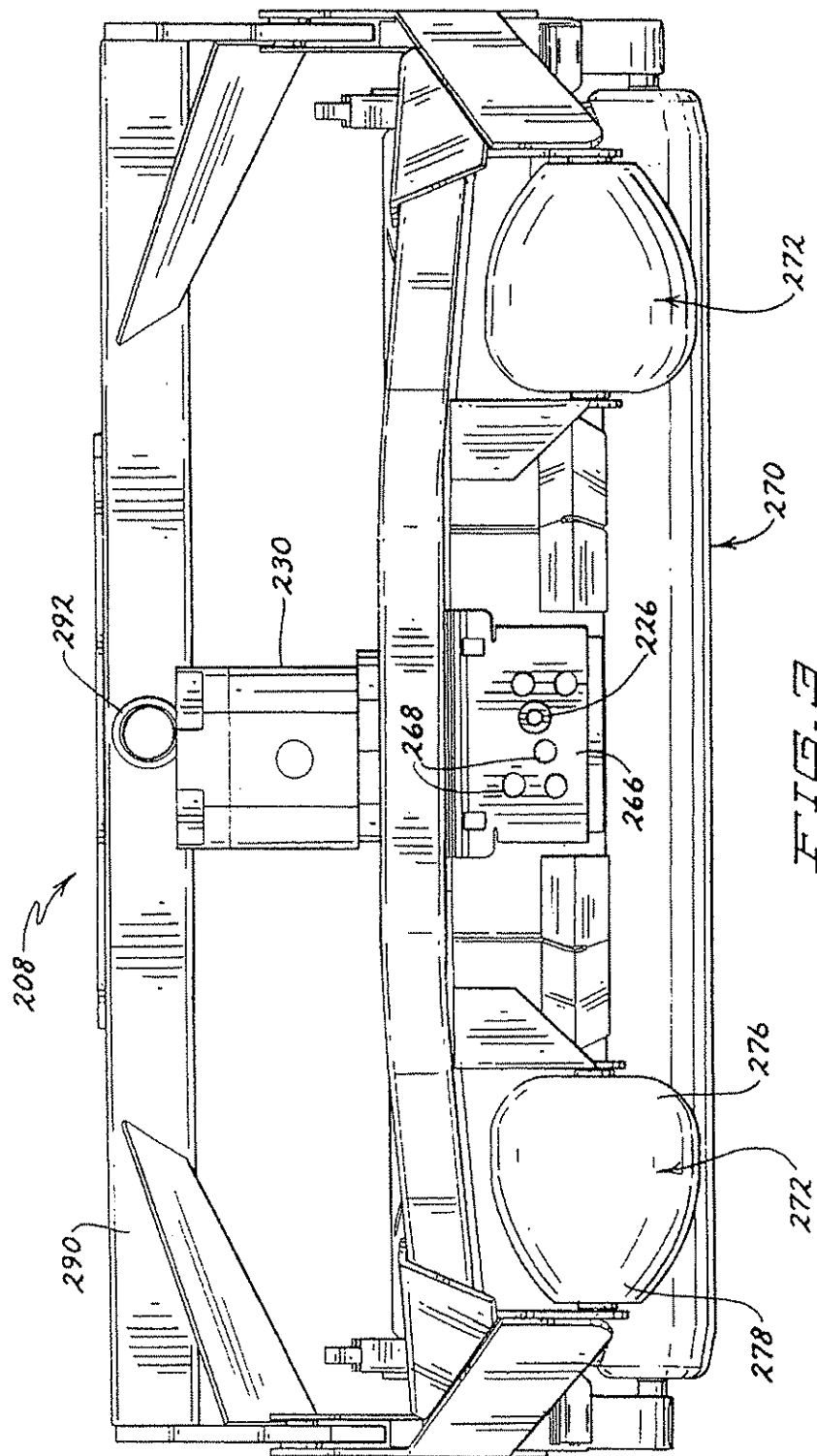


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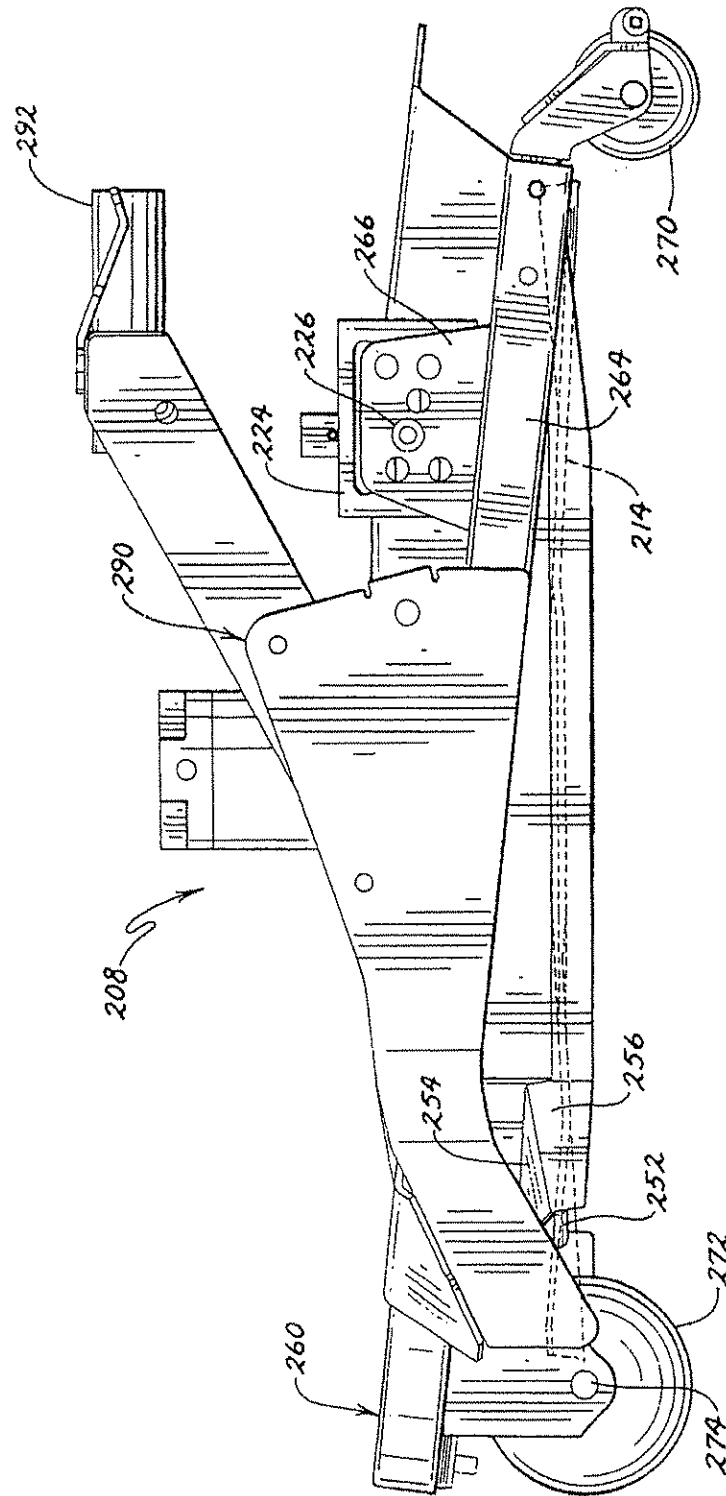


FIG. 4

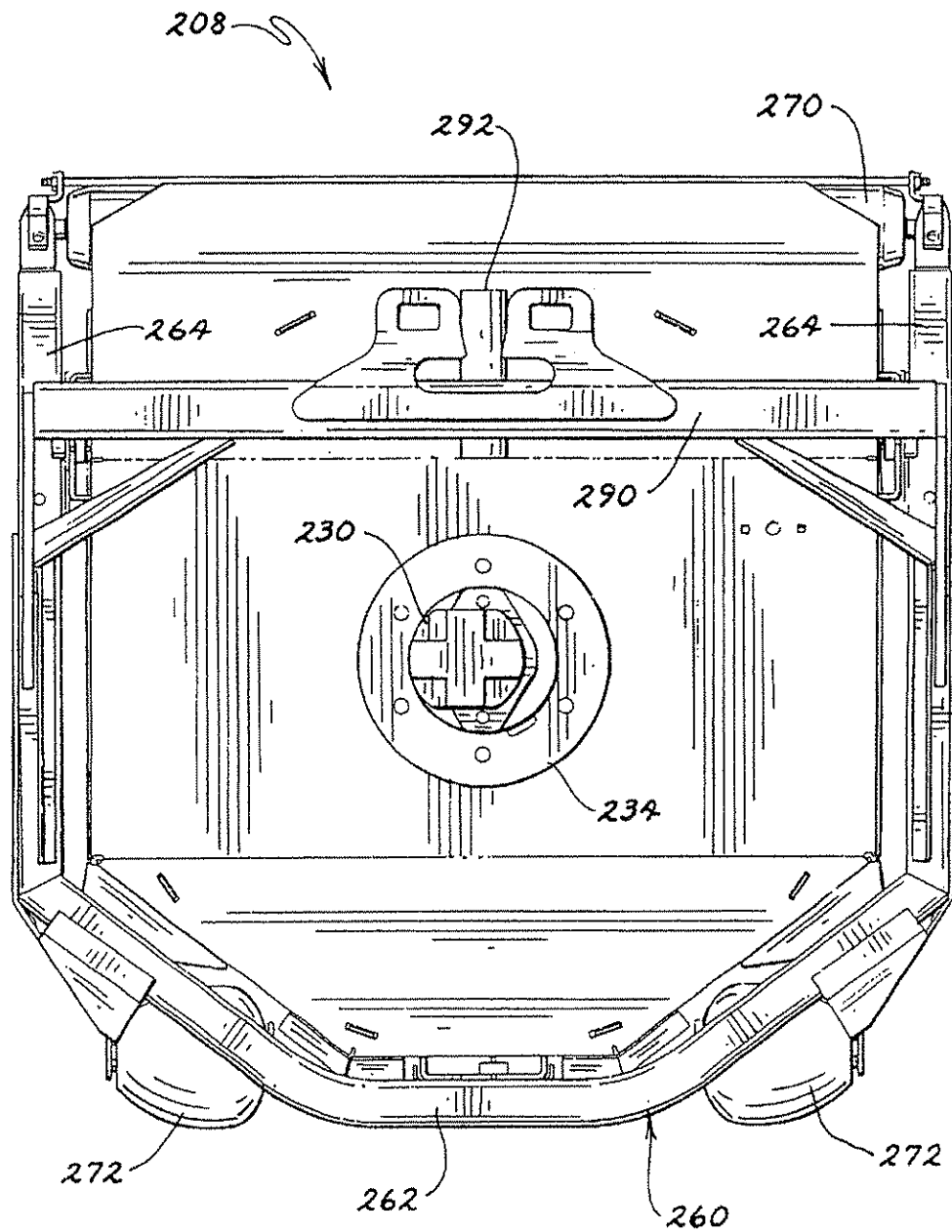


FIG. 5

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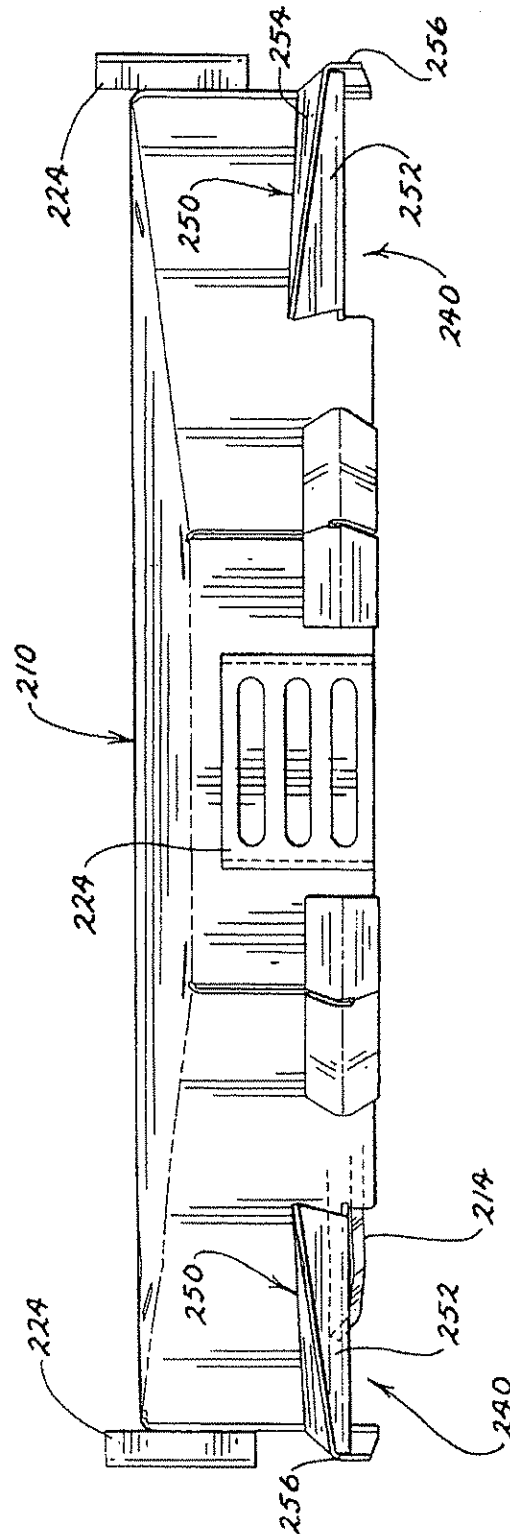


FIG. 6

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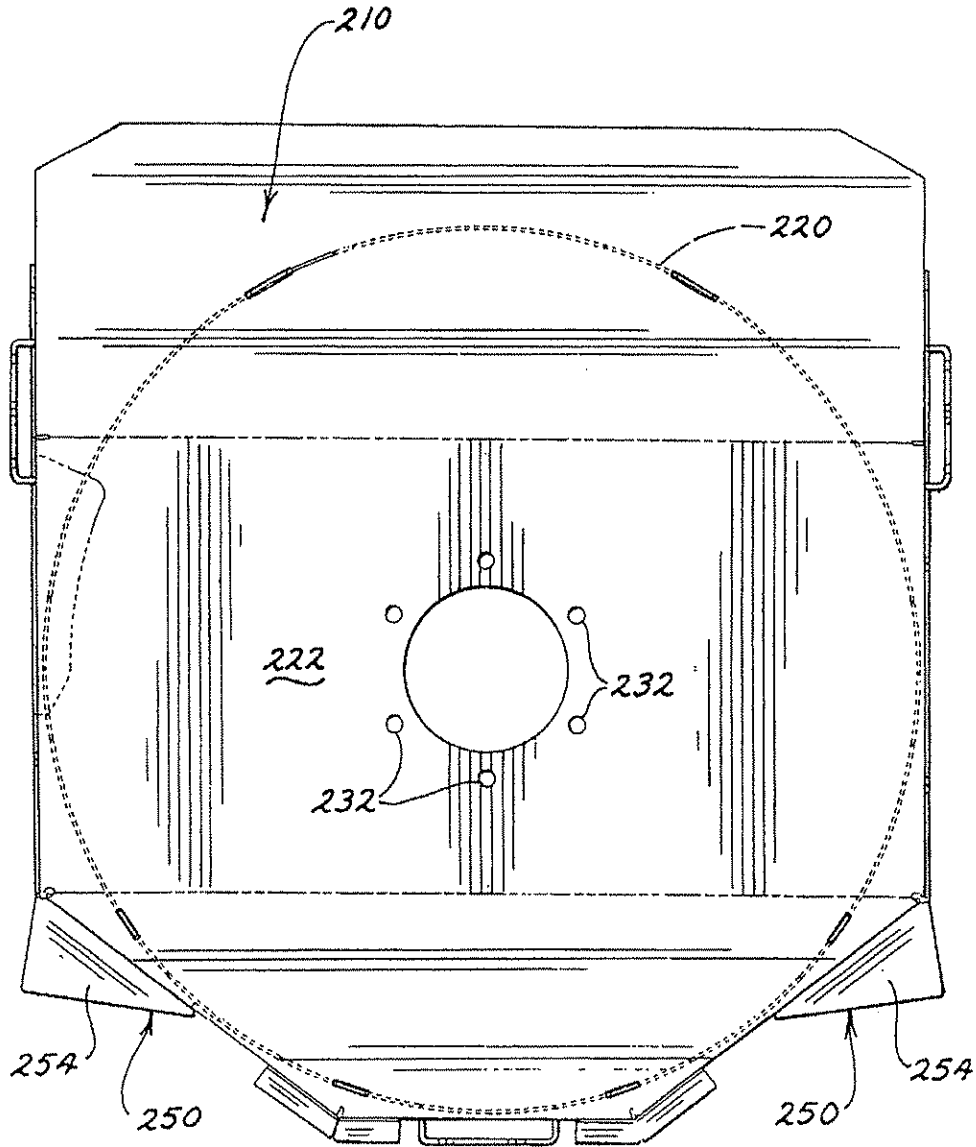


FIG. 7



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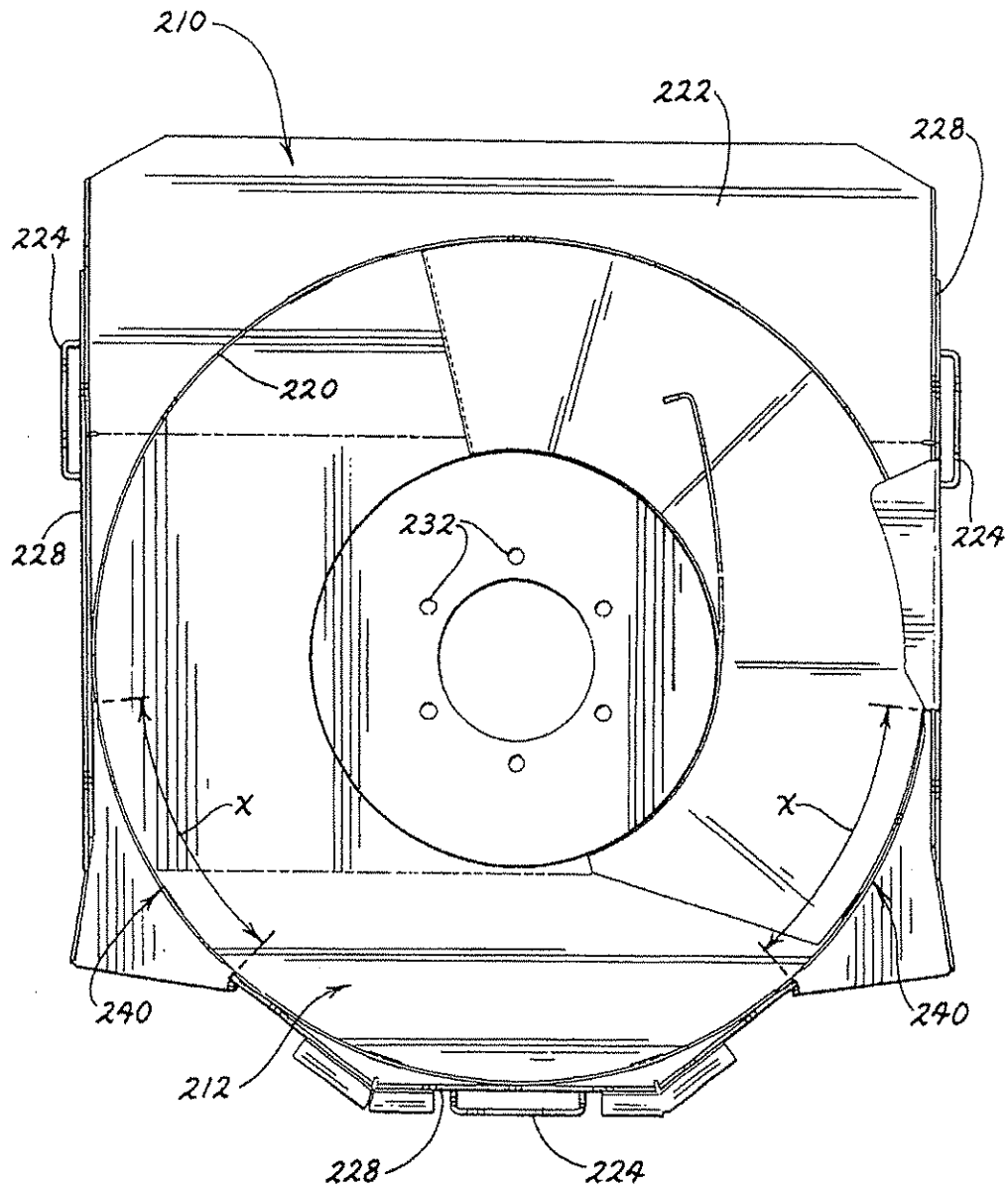


FIG. 8

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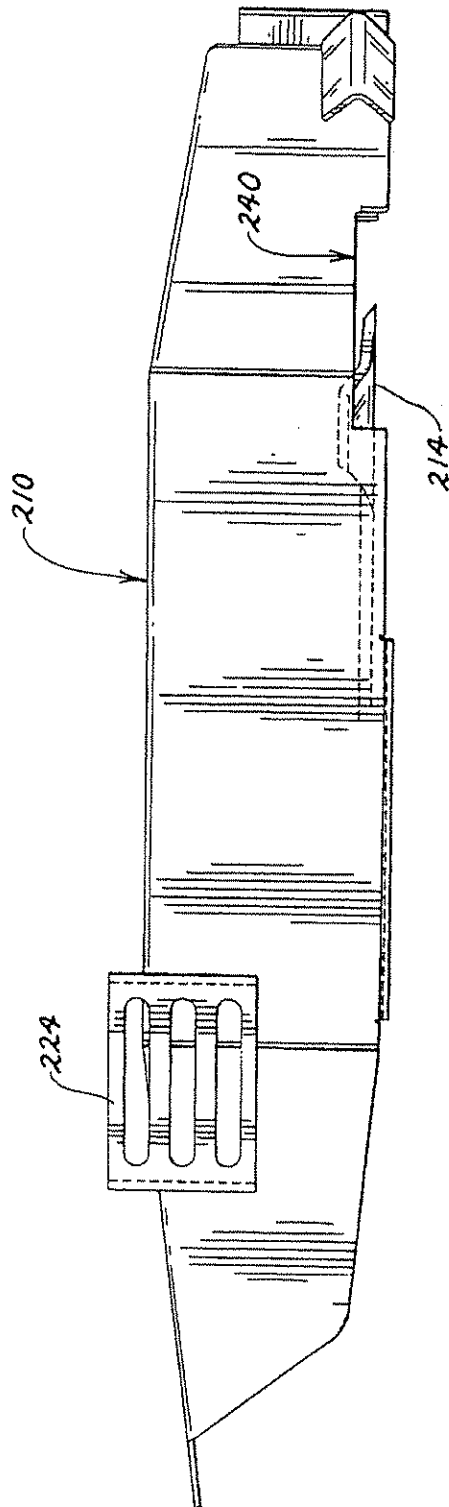


FIG. 9

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## ROTARY CUTTING UNIT WITH OVATE ROLLERS AND FRONT CORNER CUT-OUTS

This application is claims the benefit of Ser. No. 60/011, 450, filed Feb. 9, 1996.

### TECHNICAL FIELD

This invention relates to a rotary cutting unit for use on a mower, preferably a mower in which a plurality of spaced and staggered cutting units collectively cut a swath of grass as the riding mower is operated.

### BACKGROUND OF THE INVENTION

Riding mowers are known which carry a plurality of rotary cutting units for cutting a relatively wide swath of grass. For example, the Ransomes AR 250 is a five-plex rotary mower having three, front rotary cutting units arranged in a first row and two, rear rotary cutting units arranged in a second row. The front rotary cutting units are arranged in advance of the front wheels of the mower while the rear rotary cutting units are arranged between the front and rear wheels of the mower. The rear cutting units are further arranged to cover the gaps between the front cutting units. Thus, as the mower is driven forwardly and the cutting units are operated, the five cutting units cut a single swath of grass.

While such cutting units are effective in cutting a relatively wide swath of grass with each pass, the cut grass swath exhibits streaking, at least in certain grass conditions. Such streaking comprises a row or streak of uncut grass or of grass that is not cut as evenly and uniformly as the rest of the grass in the cut path. The Applicant has noticed such streaking occurring between the multiple rotary cutting units in a mower of this type, especially when the mower is turning or is traversing slopes. The streaks often occur generally along the line where one side of one of the front cutting units overlaps with a side of one of the rear cutting units. The presence of such streaks is obviously not aesthetically pleasing and is a disadvantage to such a mower having rotary cutting units.

Each cutting unit in a mower of this type carries a combination of rollers and wheels for allowing the cutting unit to roll over the ground as the mower moves forwardly. In the known Ransomes AR 50 mower, each cutting unit is supported at the rear by a full length rear roller. At the front, each cutting unit is supported by two caster wheels adjacent the front corners of the unit. The caster wheels are supported for turning about vertical pivots in a well known manner.

While the caster wheel/rear roller structure adequately supports the cutting unit for rolling on the ground, the use of caster wheels has some disadvantages. In order to support the caster wheels for free pivoting about their vertical pivots, the wheels must be set fairly far forwardly of the front of the cutting unit to allow for mounting of the pivot structure and to allow the caster wheels to swing about their vertical pivots without hitting the front of the unit. Mounting the caster wheels far enough forwardly to allow for proper pivoting of the wheels hinders or interferes with the ability of the unit to follow the ground contour and puts the support provided by the front caster wheels further forwardly relative to the blade than would be desirable. A more compact way of supporting the front of the cutting unit for rolling over the ground would be advantageous.

### SUMMARY OF THE INVENTION

One aspect of this invention is directed to reducing or eliminating streaking between adjacent cutting units. This

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aspect is provided in a mower which comprises a traction vehicle. A plurality of cutting units are carried on the traction vehicle which cutting units collectively cut a swath of grass as the traction vehicle is operated. The cutting units comprise rotary-type cutting units each having at least one cutting blade which is rotated in a substantially horizontal cutting plane. In addition, the cutting units each include a cutting deck which includes cut-outs at each front corner thereof in which the cutting blade is exposed to uncut grass approaching each front corner of each cutting deck.

Another aspect of this invention relates to ground engaging rollers for the cutting deck. This aspect is provided in a mower comprising a traction vehicle. At least one cutting unit is carried on the traction vehicle. At least two ground engaging rollers are carried on the cutting unit with the rollers being laterally spaced apart relative to one another. Each roller has an ovate shape.

### BRIEF DESCRIPTION OF THE DRAWINGS

This invention will be described hereafter in the Detailed Description, taken in conjunction with the following drawings, in which like reference numerals refer to like elements or parts throughout.

FIG. 1 is a perspective view of a mower according to the invention;

FIG. 2 is a perspective view of a rotary cutting unit used on the mower of FIG. 1;

FIG. 3 is a front elevational view of the rotary cutting unit shown in FIG. 2;

FIG. 4 is a side elevational view of the rotary cutting unit shown in FIG. 2;

FIG. 5 is a top plan view of the rotary cutting unit shown in FIG. 2;

FIG. 6 is a front elevational view of a portion of the cutting unit shown in FIG. 2, namely a front elevational view of the cutting deck with the roller frame having been detached from the cutting deck such that the cutting deck is illustrated by itself;

FIG. 7 is a top plan view of the cutting deck portion, shown in FIG. 6, of the cutting unit;

FIG. 8 is a bottom plan view of the cutting deck portion, shown in FIG. 6, of the cutting unit; and

FIG. 9 is a side elevational view of the cutting deck portion, shown in FIG. 6, of the cutting unit, with the baffles having been removed from this view to better illustrate one of the front corner cut-outs of the cutting deck.

### DETAILED DESCRIPTION

A mower according to this invention is generally illustrated as 100 in FIG. 1. Mower 100 includes a traction vehicle 102 having a pair of front drive wheels 104 appropriately coupled through a transmission (not shown) to a prime mover (also not shown). A rear steerable wheel 106, which may or may not be powered, support the rear end of vehicle 102. An operator who sits in an operator's seat 114 can steer traction vehicle 102 by means of a steering wheel 116 which, when turned, causes rear wheel 106 to pivot about a vertical axis, thereby steering the vehicle.

The Toro Company, the assignee of this invention, makes and sells a well known triplex trim mower of the type shown herein known as the Sidewinder® which carries three reel-type cutting units thereon. The cutting swath formed by these reel-type cutting units can be laterally displaced relative to the vehicle 102 using a cutting unit carrier system

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shown generally as 141. The operator can selectively laterally displace the cutting units to one side or the other using a joystick 118. When joystick 118 is laterally moved from its neutral position, it actuates a hydraulic cylinder 158 that acts through a scissors frame 146 on a laterally slidable carrier frame 144 to slide carrier frame 144 to one side or the other from a normal, generally centered orientation. The cutting units are attached to carrier frame 144 so that all of the cutting units are displaced with carrier frame 144 to similarly laterally displace the swath of grass being cut by the cutting units relative to the traction vehicle 102.

The Sidewinder® trim mower described above, in addition to being commercially available, is also shown and described in U.S. patent application Ser. No. 08/969,799, filed Nov. 13, 1997, which application is hereby incorporated by reference.

The rotary cutting units 208 of this invention are shown installed on a mower 100 comprising a Sidewinder® trim mower. In this embodiment, the three reel type cutting units present on a Sidewinder® trim mower are replaced by three rotary cutting units 208. The system for laterally displacing rotary cutting units 208 is the same as the system used in the Sidewinder® trim mower to laterally displace the three reel type cutting units. Namely, all three rotary cutting units 208 can be displaced to one side or the other from a normal, generally centered orientation on vehicle 102 using the same cutting unit carrier system 141 present on a Sidewinder® trim mower. The primary difference between the Sidewinder® trim mower equipped with reel-type cutting units and the mower 100 according to this invention is the nature of the cutting units themselves, namely the use of the rotary cutting units 208 disclosed herein rather than reel type cutting units.

A rotary cutting unit 208 of the type according to this invention is shown in FIGS. 1-9 and will be more fully described hereafter. The description of one rotary cutting unit 208 will serve to describe the other rotary cutting units 208 as all of the cutting units are generally identical. Again, since one rotary cutting unit 208 will replace each of the reel-type cutting units normally found in a Sidewinder® trim mower, there will be two front rotary cutting units 208a in advance of each front wheel 104 of vehicle 102. A third, rear cutting unit 208b will be placed beneath vehicle 102 generally between the front and rear wheels of vehicle 102. The rear cutting unit 208b will extend between and cover the gap that exists between the front cutting units 208a such that all three cutting units 208a and 208b will cut an unbroken swath of grass. Again, this staggered and overlapped orientation of rotary cutting units 208 is the same as what exists for the reel type cutting units normally found in a Sidewinder® trim mower, except that now the cutting units are rotary cutting units.

Each rotary cutting unit 208 comprises two major components that are normally fixed together during operation of the cutting unit, but are detachable from one another to change the cutting height. The first of these components comprises a cutting deck 210 which provides a cutting chamber 212 in which a generally horizontal cutting blade 214 is contained. Cutting deck 210 also mounts a motive means for rotating blade 214 in a substantially horizontal cutting plane. The other of these components includes a roller frame 216 that mounts various ground engaging rollers. When roller frame 216 is fixed to cutting deck 210, cutting deck 210 is self-supporting on the ground and can roll over the ground by virtue of the various rollers on roller frame 216. The height of cut of rotary cutting unit 208 can be adjusted by changing or adjusting the position of roller frame 216 relative to cutting deck 210 when the two are affixed together.

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Cutting deck 210 of each rotary cutting unit includes a downwardly facing cutting chamber 212 which is defined by a circular shroud wall 220 that extends downwardly from a top wall 222. As is well known in rotary cutting decks, this wall arrangement provides a generally enclosed cutting chamber 212 which is enclosed over the sides and top thereof but is open at the bottom thereof. A rotary cutting blade 214 is carried inside this cutting chamber 212 and rotates in a generally horizontal cutting plane about a generally vertical rotational axis. Cutting blade 214 has sharpened cutting edges which cut the grass as blade 214 rotates in its cutting plane. The height of cut is determined by how far blade 214 is positioned above the ground which is, in turn, determined by the relative position of cutting deck 210 on roller frame 216.

The circular shroud wall 220 of cutting deck 210 can be generally continuous and unbroken so that cutting deck 210 acts as a mulching deck. In other words, grass clippings within cutting chamber 212 will exit the chamber only through the open bottom of cutting chamber 212. However, shroud wall 220 could also be provided with a grass discharge opening to allow grass clippings to exit through shroud wall 220 in some desired direction, i.e. to the side of cutting deck 210 or preferably to the rear of cutting deck 210. Thus, whether cutting deck 210 is a mulching deck or a side or rear discharge deck is not important to this invention.

In addition, cutting deck 210 can have other walls secured to shroud wall 220 for various purposes. For example, the front and sides of cutting deck 210 are desirably flat to carry slotted attachment brackets 224 that are adjustably mated to attachment pins 226 on roller frame 216. The flat front and sides of cutting deck 210 are provided by other straight, flat walls 228 that are secured to the front and sides of circular shroud wall 220. See FIG. 8. In addition, top wall 222 extends rearwardly past circular shroud wall 220 to further unite and join the straight, flat walls 228 that are secured to the sides of circular shroud wall 220.

A means for rotating the cutting blade within cutting chamber 212 is provided on cutting deck 210. This rotating means comprises an individual electric or hydraulic motor 230. Preferably, cutting deck 210 includes a series of bolt holes 232 to which a motor mounting ring 234 can be bolted. When so mounted and when energized, the shaft of motor 230 is suitably connected to blade 214 to rotate blade 214 in its horizontal cutting plane. Alternatively, the blade rotating means could comprise a drive spindle mounted on cutting deck 210 that could be belt driven from a power takeoff shaft or the like. However, since rotary cutting unit 208 is free to pivot and tilt during operation of the mower to conform to the ground contours in the same manner that the reel-type cutting units can pivot and tilt on a Sidewinder® trim mower, the use of a belt driven spindle as the blade rotating means is not preferred due to the problems involved in keeping proper tension and alignment on the belt. These problems are avoided by using an electric or hydraulic motor 230 as the blade rotating means.

Shroud wall 220 of the rotary cutting deck has a cutout 240 adjacent each front corner of cutting deck 210. By a cut-out, it is meant that shroud wall 220 is cut away adjacent its lower edge to expose the sharpened cutting edge of blade 214 when the tip of blade 214 travels past cut-out 240. Referring now to FIG. 8, each cut-out 240 has an angular extent of about 45° designated by the arc labelled as x and is positioned on the front corner of cutting deck 210 so that uncut, standing grass approaching each front corner of cutting deck 210 will encounter or pass into one of cut-outs



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240. As shown in FIGS. 6 and 8, blade 214 is exposed to the uncut grass in cut-out 240. Otherwise, in the front of cutting deck 210 between cut-outs 240, blade 214 is hidden or enclosed by the walls which define the front of cutting deck 210.

Cutting deck 210 includes baffles 250 adjacent each of the front corner cut-outs 240 for helping guide standing, uncut grass into cut-outs 240. Each baffle 250 comprises a generally upright, triangular, first baffle surface 252 that is widest at the innermost portion of cut-out 240 and decreases in height towards the outside of cutting deck 210. This upright, triangular, first baffle surface 252 is secured to the sides of cutting deck 210 by an upper triangular support flange 254 having an outermost, vertical side 256 that wraps down over the outermost end of the triangular, first baffle surface 252. The outermost, vertical side 256 of the triangular support flange 254 extends rearwardly to join with the side walls of cutting deck 210. The outermost side 256 of the triangular support flange 254 is beneath the level of blade 214 and of the bottom of the triangular, first baffle surface 252. See FIG. 6.

Thus, referring again to FIG. 6 which shows the front of cutting deck 210, as standing, uncut grass engages the front of cutting deck 210, the grass that engages the middle portion of the front of cutting deck will simply be bent beneath the lowermost edge of the walls of the deck in the middle portion. However, the standing, uncut grass that approaches each side of cutting deck 210 will engage the triangular, first baffle surface 252 adjacent each of the front cut-outs 240. This first baffle surface 252 will tend to bend the grass smoothly down into the front cut-out 240 where the grass can stand back up and be cut without being bent to one side of cutting deck 210, the grass being further confined by the outermost side 256 of the triangular support flange 254.

When rotary cutting decks 208 are arranged in a staggered orientation as in the mower of this invention, the Applicant has sometimes noticed a streaking effect along the lines where the rear cutting deck overlaps with the front cutting deck. This streaking effect is especially prevalent when vehicle 102 is turning or traversing slopes. However, when cutting decks 210 are equipped with the front corner cut-outs 240 and adjacent baffles 250 as described and illustrated herein, streaking occurring between cutting decks 210 is substantially eliminated or reduced.

As noted earlier, cutting deck 210 by itself comprises only one component of rotary cutting unit 208. To form a complete rotary cutting unit 208, cutting deck 210 has to be united with a roller frame 216. Roller frame 216 and its attached rollers will now be described.

Roller frame 216 comprises a generally U-shaped arch 260 defined by a front rail 262 secured to two, rearwardly extending side rails 264. The width of the U-shaped arch 260, i.e. the distance between side rails 264, is wide enough to allow cutting deck 210 to be positioned within roller frame 216. Each rail 262, 264 of the U-shaped arch has an apertured attachment flange 266 that carries a plurality of holes or apertures 268 for receiving an attachment pin 226. Each attachment flange 266 on one of the rails overlies one of the slotted attachment brackets 224 on cutting deck 210 so that pin 226 can pass through a selected aperture 268 and a selected slot to affix roller frame 216 and cutting deck 210 together. The height of cutting deck 210 on roller frame 216 can be adjusted by changing which aperture and which slot receive attachment pin 226. This is how the height of cut of the cutting unit is adjusted. The U-shaped arch 260 includes a single, rotatable ground engaging roller 270 at the rear of

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side rails 264 behind cutting deck 210 when roller frame 216 and cutting deck 210 are united with respect to one another. This single ground engaging roller 270 extends all the way between side rails 264 over the full width of cutting deck 210. In addition, two, front, ground engaging rollers 272 are used on front rail 262 of arch 260 adjacent each corner of cutting deck 210. These two, front rollers 272 obviously extend over a small portion of the width of cutting deck 210 as opposed to the full length rear roller 270. Rear roller 270 need not necessarily be a full length roller, but could comprise a segmented roller or two separate rollers at each rear corner of the cutting deck including two separate rear rollers shaped like the two, front rollers 272.

The front ground engaging rollers 272 have a novel ovate shape with the rotational axis 274 of roller 272 extending transversely relative to cutting deck 210 and being arranged horizontally. The broader basal end 276 of the ovately shaped roller 272 is positioned to the interior of cutting deck 210 and the tapered outer end 278 of the ovately shaped roller 272 is positioned to the exterior of cutting deck 210. Roller 272 is rotatably arranged on front rail 262 of the U-shaped arch in any suitable manner.

The Applicant has found that the front ground engaging rollers 272 have numerous advantages. They are effective replacements for the traditional caster wheels that are often found on the front side of rotary cutting decks. However, front ground engaging rollers 272 are superior to caster wheels since they can be mounted closer to the front wall of cutting deck 210 than caster wheels. This reduces the distance between blade 214 and the support provided by front rollers 272 to minimize scalping and the like and to provide better ground contour following.

One possible disadvantage of using a front ground engaging roller 272 in place of a caster wheel is the tendency of such a roller to slide on the turf during a vehicle turn, which does not happen with a caster wheel that can freely pivot about a vertical axis. Such sliding is a disadvantage as it can mar or scuff the turf. However, the Applicant has found that the ovate shape of the front ground engaging rollers is effective in reducing marring or scuffing during turns. Put another way, the ovate shape of rollers 272 allows cutting deck 210 to smoothly slide over the turf during turns of vehicle 102 without marring or scuffing the turf.

The ovate shape of rollers 272 would also be useful on reel-type cutting units in place of a conventional full length front roller. In other words, such ovate rollers 272 would reduce marring and scuffing of the turf in a non-steerable reel-type cutting unit in the same manner as they do for the rotary cutting units 208 disclosed herein.

In addition to the U-shaped arch 260 that mounts the front and rear ground engaging rollers 272 and 270, respectively, roller frame 216 includes a yoke 290 secured to side rails 264 of the arch. This yoke 290, and particularly an elongated rod 292 on the yoke, is how rotary cutting unit 208 is attached to the cutting unit carrier system 141. Each rod 292 slips into one of the stem pivots 136 in the same manner as the reel-type cutting units on a Sidewinder® trim mower.

Rotary cutting units 208 have been shown herein installed on a riding mower platform comprising a Sidewinder® trim mower. However, rotary cutting units 208 are not limited to use in a Sidewinder® trim mower in which the cutting units 208 can be laterally displaced, but could be used as part of other riding mowers. For example, a cutting unit 208 having the disclosed ovately shaped, front, ground engaging rollers 272 would be useful in other riding mower applications. A cutting unit 208 with front corner cut-outs 240 would be

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useful in eliminating streaking between multiple cutting units even if the cutting units did not shift or were arranged in a different staggered pattern. This would also be true whether three cutting units 208 are arranged in the triplex configuration shown in FIG. 1, or five cutting units are arranged in a five-plex configuration as in the Ransomes AR 250 mower, or more cutting units are arranged in some different configuration.

In addition, various other modifications will be apparent to those skilled in the art. For example, the bolt holes 232 provided in cutting deck 210 for bolting the motor and blade combination to the deck in a single position could be replaced with slots (not shown) that are elongated in a fore and aft direction relative to the deck. Such slots would allow the position of blade 214 in cutting chamber 212 to be adjusted from a centered position to a non-centered position, i.e. to a position where blade 214 is shifted either forwardly or rearwardly in cutting chamber 212 to provide more clearance at the rear or in the front of cutting chamber 212, respectively. This adjustment would be made by sliding the bolts of the motor mounting ring either forwardly or rearwardly in the slots before the bolts are secured. Shifting the motor/blade combination towards the front allows for more efficient mulching of clippings while shifting the motor/blade combination to the rear provides a much smaller mulched clipping. Thus, the use of the aforementioned slots to allow a fore and aft shifting of the motor/blade combination is useful primarily in cutting decks in which the cutting chamber can be enclosed to mulch the clippings.

Thus, the scope of this invention is to be limited only by the appended claims.

We claim:

1. A mower comprising:

a. a traction vehicle;

b. a plurality of cutting units carried on the traction vehicle which cutting units collectively cut a swath of grass as the traction vehicle is operated, wherein the cutting units comprise rotary-type cutting units each having a cutting blade which is rotated in a substantially horizontal cutting plane, wherein the cutting blade has a tip at each end with a sharpened cutting edge on each blade tip;

c. wherein each cutting unit includes a cutting deck having a substantially circular shroud wall that extends vertically downwardly from a top wall to form a substantially circular, downwardly facing cutting chamber, wherein the cutting blade rotates within the cutting chamber without having the blade tips radially extend outside of the shroud wall of the cutting chamber and with the blade tips remaining at all times beneath the top wall of the cutting chamber;

d. wherein each cutting unit includes a plurality of rotatable ground engaging members that allow the cutting unit to roll over the ground during movement of the traction vehicle;

e. wherein each cutting deck has a front side that is forwardmost taken with respect to forward motion of the traction vehicle with the front side of the cutting deck having a pair of laterally spaced front corners comprising a left front corner and a right front corner; and

f. wherein the cutting deck has a pair of front corner cut-outs comprising a left front corner cut-out located at the left front corner of the cutting deck and a right front corner cut-out located at the right front corner of the cutting deck, wherein each front corner cut-out is

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formed by a cut away portion of a lower edge of the shroud wall, the cut away portion extending high enough up the shroud wall such that an upper edge of the cut away portion is located below the top wall of the cutting deck but above the sharpened cutting edges on the blade tips so that uncut grass can more easily enter the cutting chamber through each front cut-out to be cut by the blade.

2. The mower of claim 1, wherein each cutting deck further includes a pair of laterally extending baffles adjacent the front corner cut-outs, wherein each baffle is carried on the cutting deck substantially immediately ahead of and above one of the front corner cut-outs.

3. The mower of claim 2, wherein the plurality of ground engaging members comprise a pair of front ground engaging members located on the forwardmost side of the cutting deck, wherein each front ground engaging member is located adjacent one of the front corners of the cutting deck with one of the laterally extending baffles located between each front ground engaging member and one of the front corner cut-outs.

4. The mower of claim 3, wherein each front ground engaging member comprises a roller.

5. The mower of claim 2, wherein each baffle includes a first, generally upright, baffle surface having a lower edge that is located approximately at the level of the upper edge of the cut away portion that forms the cut-out with the first baffle surface extending upwardly relative to the cut-out such that longer uncut grass engaging against the first upright baffle surface is bent down by the first baffle surface into the cut-out.

6. The mower of claim 5, wherein the first baffle surface is inclined forwardly as it extends upwardly.

7. The mower of claim 5, wherein the first baffle surface has an upper edge located below the top wall of the cutting deck.

8. The mower of claim 7, wherein the first baffle surface has a progressively tapering height between the upper and lower edges of the first baffle surface, the first baffle surface decreasing in height as one proceeds laterally outwardly along the first baffle.

9. The mower of claim 7, further including a generally horizontal support flange extending between the upper edge of the first baffle surface and adjacent portions of the cutting deck to attach the first baffle surface to the cutting deck.

10. The mower of claim 9, wherein the support flange has an outermost vertical side that wraps down over an outermost end of the first baffle surface.

11. The mower of claim 10, wherein the outermost vertical side of the support flange extends below the lower edge of the first baffle surface to further help guide confine uncut grass and guide uncut grass into the front corner cut-out.

12. The mower of claim 1, wherein each front corner cut-out has an angular extent of approximately 45°.

13. The mower of claim 1, wherein the cutting units comprise:

a. at least two cutting units carried on the traction vehicle with the first and second cutting units being longitudinally aligned with one another but being laterally spaced from one another to have a gap therebetween; and

b. at least one additional cutting unit carried on the traction vehicle which is longitudinally spaced from the first and second cutting units and is located relative to the first and second cutting units to cover the gap between the first and second cutting units.

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